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REMARKS ON FOSSIL SHELLS FROM THE COLORADO DESERT.[1]

BY ROBERT E. C. STEARNS.

A LUMP of earth from the Colorado Desert which it is here proposed to investigate, is not without interest. It is part of a much larger piece recently brought from Walter's station, a point on the Southern Pacific railroad, in California, where it was selected by Prof. Geo. Davidson, who has furnished the special facts as to locality.

It is composed of clayey sediment, and was brought to the surface, from near the bottom of a well recently sunk by the railroad company at the above named place, during the process of digging through the dry deposit in a forty-inch tubing (an old smokestack). At forty-five to forty-seven feet the water-bearing stratum was struck, when the water burst up and filled the tube to within twelve feet of the surface. The continuous pumping out of a two and a-half inch stream does not lower the water line in the well. The lump, it will be noticed, contains many small shells. The larger portion of the original piece readily dissolved in hot water, in which it at once separated. Thinking it might contain diatoms or other minute microscopic forms, some of it was examined by Dr. A. M. Edwards, without, however, any being detected. The shells, though small, are easily seen without a lens, are all fresh-water forms and are also found

[1] Read before the California Academy of Sciences.

in great numbers (sometimes in windrows) at various places on the surface of the desert.

Physa humerosa Gould. Natural size.

One of the species from the well is *Physa humerosa* Gould, of which there is a single specimen; the others, of which there are numerous examples, are *Tryonia clathrata* Stimpson, and *Tryonia protea* of Gould. These latter belong to the family of *Rissoidæ*, and were described several years ago from specimens collected by Prof. Wm. P. Blake. They have also been collected by several other parties. From the late lamented Col. Albert S. Evans,[1] I received, several years ago, half a pint of these desert shells, and from others I have received a great number; probably altogether as many as 40,000 specimens have passed under my inspection, including the above and a single species of *Amnicola* (*longinqua* Gould), as well as fragments of a *Planorbis* and of *Anodonta californiensis* Lea. It is not unlikely that if we had a sufficient quan-

$\frac{4}{1}$ $\frac{4}{1}$ $\frac{4}{1}$ $\frac{5}{1}$ $\frac{5}{1}$

Tryonia protea and varieties (semi-fossil). Colorado Desert, Cal. From nature, by Stearns.

tity of sediment from the well, we should find that it contained all of these forms. All of the great number of specimens which passed under my observation, are in a fossilized or semi-fossilized condition, either of a clear opaque white (in this respect resembling the fossils of the Paris basin), or more or less translucent, though more or less silicified, while the delicate sculpture is as perfect as ever.

The surface of the desert at the point where the well is situated is 195.54 feet below the level of the ocean, as indicated by the

[1] Col. Evans was lost at sea, while on his way from New York to Brazil, by the burning of the steamship *Missouri* off the Bermudas.

barometer. Shall we indulge in a guess as to the depth of the water when these shells were alive; shall we add the depth of the well to the above figures, and again add the elevation of bench-marks, the ancient levels[1] which form terrace lines in some places along the distant hills, once a part of the shores of a now extinct lake, the walls of the basin which once enclosed and held a fresh-water sea?

It may have been, however, that the lake was never as deep as the figures thus added would indicate, and that instead of a lake or series of lakes, there existed only a lagoon or chain of lagoons, connected or disconnected, according to the volume of water, which probably varied one season compared with another; a system of shallow reservoirs, receiving the catchment or surplus surface water in periods or seasons of unusual rainfall; sometimes after a prolonged and widespread storm of great severity, uniting and forming an extensive expanse a few feet only in depth, as was seen in the valleys of California during the notable winter of 1861–2.

The rate of depression may have been such as to continue to keep the lagoons supplied during ordinary seasons with catchment or surface water from the immediate neighborhood, and have been so proportioned (involving the mean of supply) to the rate of evaporation, that only within a very recent period has this depressed portion of the Colorado basin become bare and dry.

Are the phenomena which this vast and remarkable region exhibits—of which that portion usually called the desert, is but a part—the result of catastrophic action, sudden, violent and widespread, or the result of gradual changes moving slowly through countless centuries?

The physiognomy of the wider and more general region in some of its aspects indicates action which, in geologic time is unmistakably recent, and the varied phenomena here exhibited, are more likely the result of periods of slow movement as well

[1] For miles and miles I traced with the eye a strange, well-defined line along the mountain sides, always at the same level * * * Riding out to it I found it to be the old beach of a sea.

The rocks were worn and rounded up to that level, * * * above that line the rocks were sharp and jagged. The surveying party of the Southern Pacific railroad, in running the line to Fort Yuma, struck the present sea-level the moment their instruments reached this ancient beach.—*Dr. J. P. Widney in Overland Monthly, Vol. x, 1873.*

as periods of convulsive action, recurring cycles of sudden and of gradual changes, operating through different but succeeding geologic ages or periods of geologic time. Prof. Whitney has pointed out the coincidence of mountain peaks of extraordinary elevation and areas of extraordinary depression (below the sea level), which are a part of the peculiar characteristics and striking topographical features of the same general area.[1]

During the pliocene epoch the site of the present desert was occupied by the sea or was, perhaps, a part of the Gulf of California.

"Beds of * * * Miocene and possibly Pliocene fossils are found at the mouth of Kern River cañon, showing that the sea then washed freely against the foot of the Sierra; there is even reason for believing that it extended far up the Colorado River basin; and certainly it deposited a thick bed of the enormous Miocene oyster (*O. titan*), with other remains along the west shore

[1] For most interesting information as to the height of mountains, the depression of Death and other valleys, saline plains, alkaline lakes, mud volcanoes and other phenomena which mark the physiognomy and relate to the general aspect of this wonderful region, attention is directed to Vol. i, Geol. Survey of Cal. (by Prof. Whitney), also Whitney in Proc. Cal. Acad., Vols. ii, iii and iv; Veitch in Vol. i, *id.*; Col. Williamson in Vol. iii, *id.*; Cooper in Vol. v, *id.*, and Lieut. Wheeler's Annual Report for 1876. Another author, Dr. J. P. Widney, from whose interesting article in the *Overland Monthly* (January, 1873) I have previously quoted, writes as follows of the Colorado Desert.

Crossing by the San Gorgonio Pass, the continuation of the Sierra Nevada range back of San Bernardino, the traveler leaves the fertile coast valleys [of California] and enters upon what appears * * * * the * * remains of some ancient world. As he came through the * * pass, upon his right towered San Gorgonio Peak, * * 10,500 feet in height. Upon the left forming the other wall of the pass, pine-clad San Bernardino * * reaches an altitude of 11,500 feet. But leaving now the mountains behind he descends into what seems the scorched, blasted bed of some old cyclopean furnace * * * San Gorgonio and San Bernardino on this side have lost their pines, and brown, barren and desolate, frown down upon yet greater desolation. Upon the west * * * stretch the Sierra in an unending line—a forbidding rugged wall. At the north, a spur from this main chain turns off eastward, and then curving around bears to the south, parallel to the Sierra, making another abrupt wall, which at last drops down and is lost near Fort Yuma. Inclosed by these mountains, open only toward the south, where 200 miles away it faces out upon the waters of the Gulf of California, is the Colorado Desert.

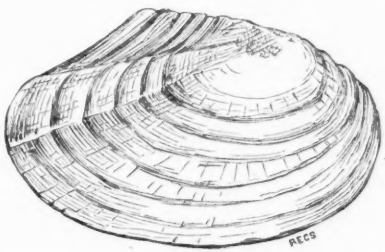
Surrounded upon every side by mountains, except in one direction, and there opening out upon the head of the Gulf of California; it shows that the desert is a portion of the old gulf which then extended 200 miles above its present limit. The cause of the separation of the upper end of that gulf, making what is now the Colorado Desert, is so apparent, that a moment's examination reveals it. The same

of the present Colorado desert, now at an elevation of probably 1000 feet."[1]

The sedimentary deposits super-imposed upon the more ancient sea or gulf bed, the top of which now constitutes the floor of the desert are geologically of very recent origin.

The perpendicular section of nearly fifty feet cut by this well, as shown by the character of the stratum cut through in connection with the shells contained therein, indicates a gradual deposit, a slow settling of sediment; the fragility of the shells and their present unfractured condition, prove that they were never subjected to abrasive action; that they were not swept violently from distant places to this, and here buried pell-mell beneath and among the varied detritus of great freshets.

Here probably was the home of *some* of these species, the metropolis of *Tryonia*, if not its specific center, which has only been



Anodonta californiensis Lea. Rio Colorado, Cal.

found sparingly elsewhere, and was supposed to be extinct. Ninety per cent., if not more, of the shells found here belong to this genus.

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agency is still at work, widening the space between the Gulf and the desert. Here nearly 150 miles from the head of the ancient gulf came in from the east side the Colorado River, bearing in its thick floods, quicksands and the red mud from the great plateaus of northern Arizona which gives the river its color and its name. The contour of the country shows the gulf to have been narrow here. The filling in of this alluvial deposit went on unceasingly, as at the mouth of every great river which enters the sea at a sheltered point. The water grew constantly shoaler, until at length the separation was complete. The alluvial deposit has steadily increased the distance between the gulf and the low bed of the desert, until now the division is marked by a narrow neck of thirty or forty miles of land but little raised above the sea level. (Dr. Widney, in *Overland Monthly*, Vol. x. See also various papers on Arizona, &c., and the Colorado river, in Vols. iv, vi, and ix, *id.*)

[1] Cooper in Proc. Cal. Acad. Sci., Vol. v, p. 403.

Mr. Tryon reporting on certain shells collected by Lieut. Wheeler's expedition in Utah Territory, says,

"Included in the collection are two specimens of the genus *Tryonia* Stimpson. This curious little genus was heretofore considered to be restricted to the Colorado Desert of southern California. * * Two species have been described, viz: the type *T.* (*Melania*) *exigua* Conrad, of which *Melania protea* Gould is a synonym, and *Tryonia clathrata* Stimpson. The two Utah specimens are probably *T. exigua*."[1]

The lump of earth from which the specimens mentioned were obtained was about the size of one's fist, yet this comparatively small matrix contained as many as three hundred. What an inconceivable number must have been propagated and buried here, what numberless generations have been born and died, since the lowest foot in this perpendicular well-section was deposited, to the last and most recent deposit, when the present surface was reached and completed! If the mind is unable to comprehend what is equally imperceptible to the eye, the numbers buried *beneath* the surface, the mind also fails to comprehend what *is* visible to the eye, the vast number which are seen *on* the surface of the desert in crossing it, the external skeletons of the vast multitude left on the top of the last deposit, when the last inch of water evaporated and left a sterile and windswept waste, upon which to-day are scattered untold millions of these tiny forms.

If we may assume that the species to which these forms belong no longer exist, within the more special area under consideration, they must have become extinct within geologically a very recent time. An examination shows the sculpture to be wonderfully sharp and well defined, yet probably the life of these minute organisms, that is to say, the specific life, had an earlier genesis than that of the human race, and the particular specimens before us were living, at a time, prior to the appearance of man on the planet.

We have here also an illustration of the relation of life and species to environment, as shown in the extinction of the former, through a radical change in the latter.

In connection with the total evaporation of the former lake or lagoons as above, it should not be inferred therefrom that the particular portion of the desert incidentally under consideration,

[1] Proc. Phil. Acad. Nat. Sciences, May 1, 1873.

has been permanently and continuously dry ever since the extinction of *Tryonia*, but that through evaporation, *it ceased to be permanently covered* with water, and though since at various times, a greater or less area has been so covered—the extinction of *Tryonia* proves that there must have been a period of drouth, a maximum both as regards degree and duration which destroyed the limited fauna, the few species which once existed here—though some of the species which I have named belonging to the genera, *Anodonta*, *Physa*, and *Planorbis*, having an earlier genesis, are known to have a wider distribution, and migrated hither, as they are still found living in regions more or less distant, as will be shown farther on; and it is barely possible that a living colony, a remnant of *Tryonia* may yet be discovered somewhere within the desert area.

It has been implied herein that the metropolis of the form called *Tryonia* was here in the former lake or lagoon region of the Colorado desert or basin, for the reason of the great multitude of individuals; its specific center may have been far to the north, nearer to the point from which the Wheeler specimens, referred to by Mr. Tryon, were obtained; it has not been found and is not known to be living elsewhere, at the present time. As to the other molluscan forms which once lived here and are now found dead either at or below the surface, an inquiry as to the localities where they are still found living,[1] and the probable paths of distribution which brought them together as congeners or

Amnicola longinqua Gould (showing range of variation). Drawn by Stearns from recent specimens collected by Henry Hemphill, in Utah Territory.

neighbors of *Tryonia*, incidentally furnishes further information pertaining to the specific region formerly occupied by these species.

[1] *Amnicola longinqua*, has recently been collected *living* in Utah by Mr. Hemphill.

An examination of Lieut. Wheeler's Drainage Map[1] of the territory west of the one hundredth meridian, shows the position of the Colorado as related to the other basins, to be diagonal, its general trend being north-easterly and south-westerly.

"The region of country drained by the Colorado and its tributaries is about 800 miles in length and varies from 300 to 500 miles in width, containing about 300,000 square miles, an area larger than all the New England and Middle States, with Maryland and Virginia added, or as large as Minnesota, Wisconsin, Iowa, Illinois and Missouri." [2]

While it may be presumed that these forms so intimately related have gradually through a great period of time spread from the higher altitudes to the lower, from the older formations to the more recent, extending the area of their distribution as fast as the emergence of the land above the sea and the emerged surface had undergone those modifications necessary to fit it for their occupancy, and are still spreading to new localities; so perhaps in other portions of the area of their domain they are decreasing or dying out, or have already died out, through modifications in the environment as in the now dried up lake or lagoons of the Colorado desert.

It is highly probable that at numerous places within the great interior basin, after the emergence of the land, fresh water lakes, ponds and streams occurred and existed for a time, and became peopled, in part by fluviatile species, such as we are now considering, including varieties of the mussels, intermediate and connecting links between the desert specimens and those from the Wahsatch stations referred to.

It is to be expected that in course of time when this great interior wilderness is thoroughly explored, that living specimens will also be found in those streams and lakes whose waters are still sweet; and with a sufficient number of specimens living and fossil from these two classes of stations, we may be able to trace the lines of distribution, which followed not alone the direct course of streams, for instance like the Colorado, but descended also to the great basin from the now lofty altitudes of the Sierra Nevada, and the parallel ranges on its eastern flank on one side, as from the corresponding regions in the Wahsatch range and sub-

[1] In Lieut. Wheeler's Annual Report, 1876.

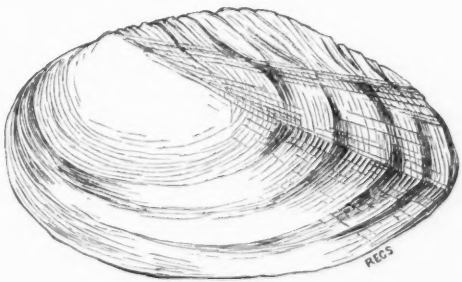
[2] Exploration of the Colorado of the West, etc., by Prof. J. W. Powell, 1875, p. 3.

sidiary ranges upon its western flank on the other, spreading laterally as well as in the direction of what may be regarded as the great highways furnished by the main stream and its principal confluents.

That we may have a better idea of the Colorado river and its tributaries, and of the regions traversed by the latter, I will quote the eloquent description of Prof. Powell.

"There are two distinct portions of the basin of the Colorado. The lower third is but a little above the level of the sea, though here and there ranges of mountains rise to an altitude of from two to six thousand feet. This part of the valley is bounded on the north by a line of cliffs, which present a bold often vertical step, hundreds or thousands of feet to the table lands above.

The upper portion of the basin rises from four to eight thousand feet above the level of the sea. This high region on the east, north and west, is set with ranges of snow-clad mountains attaining an elevation above the sea varying from eight to fourteen thousand feet. All winter long on its mountain crested rim, snow falls, filling the gorges, half burying the forests, and covering the crags and peaks with a mantle woven by the winds from the waves of the sea—a mantle of snow. When the summer sun comes, this snow melts, and tumbles down the mountain sides in millions of cascades. Ten million cascade brooks unite to form ten thousand torrent creeks; ten thousand torrent creeks unite to form a hundred rivers beset with cataracts; a hundred roaring rivers unite to form the Colorado, which rolls, a mad, turbid stream, into the Gulf of California."



Anodonta. Owen's River, Cal.

While the specimens from Washoe lake are in every feature so close to those from Bear river in the distant Wahsatch range, the mussels inhabiting Owen's river at an elevation of 4000 feet on

the easterly flank of the Sierra Nevada, exhibit a considerable variation when compared with those from the preceding places.[1]

The Owen's river specimens, though inhabiting so elevated a station, closely resemble those found at, and in the neighborhood of Los Angeles at an elevation of only 280 feet, and the specimens from both of these places as well as specimens from other stations with similar elevations within the southern portion of the limits of the coast drainage area of California as shown in Lieut. Wheeler's map, and which stations more closely approximate to the level of the desert region, are exceedingly close in their general aspect and minuter characters to the dead shells of the extinct lagoons, and to Lea's type[2] from the Colorado, presumably in the neighborhood of Fort Yuma. At many points within the drainage area described in the foregoing reports the *Anodontæ* have been detected.

I am under obligations to Dr. Edward Palmer for specimens from Utah lake, and to Mr. Henry Hemphill for specimens from Bear river, also in Utah Territory. These localities are in the Wahsatch range, at an elevation of over 4,500 feet above the level of the sea.

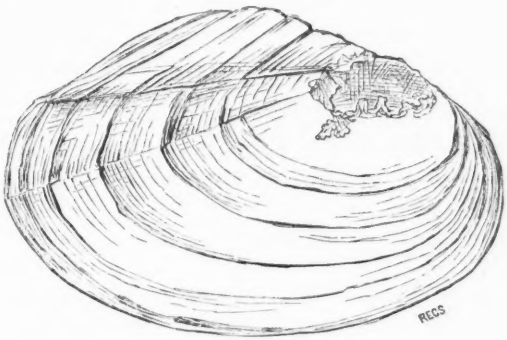
The differences between the specimens from these two locali-

[1] The Owen's lake has no outlet and is fed by the Owen's river, a stream about thirty feet wide, two feet deep and having a velocity of about five miles per hour. As the level of the lake remains constant, there must be perfect equilibrium between the amount of evaporation and the incoming water. The lake having one hundred and ten square miles of surface, and evaporation of 4.6 feet per year, would suffice to swallow up the annual volume of Owen's river.

Those who cannot appreciate the amount of evaporation, have invented the hypothesis of a subterranean outlet, as in the case of the Great Salt Lake in Utah.—*Wheeler's Annual Report, 1876, p. 189.*

[2] Explanatory of my allusions to variation, herein, as shown by a comparison of the Anodons from one place with those from another, to prevent misapprehension I should state, that I do not regard variation as exhibited in the West American forms under discussion, as of specific value, a conclusion I have arrived at after a long and careful study of the relation of variation to environment. While forms or colonies of a form belonging unquestionably to the same species, and inhabiting stations only a short distance apart, often exhibit aspects of variation in such a degree as to appear phenomenal, the cause thereof not being immediately obvious, a careful investigation of the environment frequently rewards us, if not with a full explanation, with a clue or a ray of light.

ties are these: The river shells present a somewhat more ovate outline, are rather more elongated transversely, and are darker colored than the lake specimens. These Bear river mussels are so exactly like those collected by Mr. C. D. Voy in Washoe lake,



Anodonta. Bear River, Utah Territory.

which has an elevation of 4,000 feet in the Sierra Nevada, that though the two regions are separated by between seven and eight degrees of longitude, if numbers of individuals of the same sizes from these two localities were mixed without previous marking, they could not be segregated, with any degree of certainty, so closely are they alike in form, color, incremental lines and zones, which warrants the assumption that the factors of the environment are the same at both stations.

The fragments of *Anodontæ*, met with in the desert, are portions of shells (valves) having the same outline as that figured and described by Dr. Lea, in 1852,[1] from specimens collected by Dr. J. L. LeConte of Philadelphia, in the "Rio Colorado, California," and which Lea remarks as closely allied to "*An. nuttalliana*" from the "Wahlamet river, Oregon," previously described by that author.[2]

[1] Trans. Am. Phil. Society, 2d Series, Vol. x.

[2] Eight species of fresh water mussels have been described from Western North America, west of the Rocky mountains and north of Mexico; of these six belong to the group *Anodonta;* of these six *Anodons*, four, namely *A. nuttalliana*, *A. wahlamatensis*, *A. oregonensis* and *A. californiensis*, are regarded by me as varieties of one and the same species.

In a paper "On the variation of the fresh water mussels," etc., of this western region of America, now nearly ready for the press, I point out the features of their variation and indicate the influences which have induced it. Seven of the eight species alluded to, were described by Dr. Lea.

The remarkable season of 1861-2, when the great California basin was flooded and the larger portion of the valleys included between the coast range and the Sierra Nevada was for weeks covered with water, and connected at times, so as to form an extensive lake, this winter also embraced within the area of its severity the more interior basin east of the Sierra. While, doubtless, the volume of the Colorado was greatly increased through the contributions of its tributaries in its upper portion, it also must have received an extraordinary supply from the drainage slopes farther to the south. The record of unusually high water or floods in the Colorado includes the winter of 1861-2 as well as several seasons not remarkably wet in California. In the preliminary report of Lieut. Bergland,[1] on the feasibility of diverting the Colorado for the purposes of irrigation, he estimates the area of depression below the sea level within the limits of California at approximately "1,600 square miles," yet during the severe winter especially referred to, an area estimated to be sixty miles long by thirty miles wide was covered with water.[2] A portion of this was without question the surplus surface drainage from the adjacent country as well as the overflow of the Colorado, though the New River channel, and the main stream may have poured a portion of its water, in times gone by, over the desert, through other channels.

The sedimentary deposit under consideration and the lake whose waters once held it in suspension, and covered the present desert, may be accounted for in this way, and its permanence, over the area covered and the depth of water on which its area depended, only required a more constant volume in the Colorado, a less rapid rate of evaporation, even if the topographical features are the same now as then.

With the data accumulated by various intelligent and trustworthy observers, and accessible to all who are disposed to investigate, we are justified in the conclusion that without spasmodic

[1] Wheeler's Report, 1876, p. 109.

[2] Mr. Jaeger, owner of the Ferry at Fort Yuma, and a resident of the place since its establishment as a military post, says, "Heavy floods in 1840, 1852, 1859, 1862 and 1867. Tasted the water flowing in channel at New River station in 1862, and found it fresh water. A Mr. Jones (now dead) told me that he came along the west side of the great basin in 1862, on his way from San Bernardino to New River, and saw in the basin a great lake, some sixty miles long by thirty wide. This came from the overflow in 1862." Id. 118.

or catastrophic action, the present condition of the desert is the result of gradual and slowly working causes, and that within comparatively recent times, there has been a decreasing mean average rain and snowfall to the north, in the higher regions which are drained in this direction, and also an increasing but gradual elevation combined with increased evaporation.

While *Tryonia* as before stated is apparently local, the other species are widely distributed. The *Anodontæ* (mussels) not only inhabited the area from the Wahsatch mountains on the east, to the Pacific ocean on the west, but from the Colorado on the south to and north of the Columbia river in the north, their migration in the latter direction having been from the Wahsatch region also, as appears probable when we consider the statement of Dr. James Blake,[1] "that the divide between the waters of the Great Basin and of the Columbia is the ridge * * * in latitude 41° 33′ N., longitude 113° 29′ E., * * * 600 feet (in height) above the level of the Salt Lake basin." And further he remarks "the height of the divide above the level of Queen's River valley is about six hundred feet, but I am of the opinion that other outlets must exist, which allowed the waters of the basin to attain a still lower level, before their disappearance solely by evaporation began. There must have been a large body of water left to disappear by evaporation, as the concretionary deposits * * * are found at an elevation of two hundred feet above the level of the valley and they could only have been deposited as the water became concentrated by evaporation. * * * Large numbers of *Anodonta* shells are found on the surface of the ground, entirely encased in this concretionary substance, to the thickness of two or three inches."

Of the two forms of *Planorbis* (*P. gracilentus* Gould, found dead in the desert, and *P. ammon* Gould, found living in the Colorado river) one is closely similar to other widely distributed

[1] Proc. Cal. Acad. Sci. Vol. iv. (p. 277, Oct.) 1872.

Dr. Hayden believes that his parties have fixed the position of the ancient outlet of the great lake that once filled the Salt Lake basin. This appears to have formerly drained into the Columbia river; and the lowest pass between the great basin and the drainage of the river is continued directly south at the head of Marsh creek, and so low is it that one marsh connects two streams, one flowing to the Bear river and the Great Lake, and the other to the Portneuf and Snake rivers of the Columbia. This generalization was actually made several years ago, but only fully established during the past season.—*Harper's Weekly, March 2d, 1878.*

forms, to which authors have given many specific names, but which I regard as varieties only of one and the same species. The *Physa* (*P. humerosa*), also though a well marked form in certain respects, I am inclined to place as simply a southern or warm climate variety of the widespread *P. heterostropha* Say, which inhabits an area extending from the Atlantic seaboard, to the Great Slave lake in the north, to the Pacific coast on the west, and is found also in Utah Lake.

And here I would remark that I do not assert that the distribution of these several molluscan forms may not have been through other channels and by other lines; from the Sierra perhaps, down its eastern flank or from some point or points in the coast range further to the east.

There are other agencies and methods of distribution, which I will refer to briefly, before closing. The *Anodontæ*, for instance, when young, sometimes attach themselves, by their valves, to the fins of fishes, and are carried to new localities in this way, as well as by being swept along by streams. Physa and Planorbis in their embryonic stage are contained in a soft and sticky mass of jelly; this gelatinous mass adheres to the legs and feathers of birds, especially aquatic species, and is carried often to great distances from the original habitat; again tornadoes and water spouts act as distributing agents, taking up the waters of lakes and streams, and the chips and twigs which frequently abound therein, and transporting the same to places many miles away, where they are deposited, sometimes, in other streams or ponds. It is quite common to find the sticky egg-mass as well as adult individuals of the fresh water snails, adhering to such objects.

And now after a somewhat prolonged and perhaps tiresome journey over a rather wide region, pursuing such suggestions as have been evolved from time to time during the progress of our inquiry, let us return to the place of beginning, where I will conclude by repeating the noteworthy facts, perhaps without parallel elsewhere, namely the level of the Southern Pacific Railroad in the Colorado desert, as compared with that of the ocean. Here we have several miles of railway upon a plane nearly 200 feet below the sea level, and locomotives supplied with fresh water from a well 240 feet below the level of the ocean; the latter, if not the deepest, being certainly one of the remarkable wells of the world.

THE DISTRIBUTION OF THE NORTH AMERICAN FLORA.

BY SIR JOSEPH DALTON HOOKER.[1]

WHATEVER countries beyond the seas we may visit, in the temperate regions of the globe, we find that their vegetation has been invaded, and in many cases profoundly modified by immigrant plants from other countries, and these are in almost all cases natives of North-western Europe. Nearly forty years ago I arrived at night at the Falkland islands, when a boat was sent ashore to communicate the ship's arrival to the Governor; and, being eager to know something of the vegetation of the islands, I asked the officer in charge of the boat to pluck for me any plants he could feel for, as it was too dark to see anything, and the armful he brought to me consisted of nothing but the English shepherd's purse. On another occasion, landing on a small uninhabited island,[2] nearly at the Antipodes, the first evidence I met with of its having been previously visited by man, was the English chickweed; and this I traced to a mound that marked the grave of a British sailor, and that was covered with the plant, doubtless the offspring of seed that had adhered to the spade or mattock with which the grave had been dug.

It was hence no surprise to me to find myself, on landing at Boston last summer, greeted by Western European plants that had established themselves as colonists in New England. Of these the first was the wild chicory, growing far more luxuriantly than I ever saw it do elsewhere, forming a tangled mass of stems and branches, studded with turquoise-blue blossoms, and covering acres of ground; the very next plants that attracted my attention were the oxeye-daisy and Mayweed, which together whitened the banks in some places, and which I subsequently tracked more than half way across the continent.

These, and more than two hundred and fifty other Old England plants, which are now peopling New England, were for the most part fellow-emigrants and fellow-colonists with the Anglo-Saxon, having (as seeds) accompanied him across the Atlantic, and having, like him, asserted their supremacy over and displaced a certain number of natives of the soil.

[1] A lecture by Sir Joseph Dalton Hooker, K.C.S.I., Pres. R. S., delivered on April 12, 1878, before the members of the Royal Institution of Great Britain. [Reprinted from the *Gardeners' Chronicle*, August, 1878.]

[2] Lord Aukland's island, south of New Zealand.

Turning to the hotter parts of North America, the same process of invasion by natives of the Old World is going on: a British-Indian plant[1] has established itself in the streets of Savannah, and so entirely simulated the habit of a native weed, that American botanists gave it a new name, regarding it as indigenous; and one of the most curious cases of plant invasion known to me is that of the mango tree in Jamaica, which reminds one of the accounts of captured tribes, which, after being carried into their conqueror's country, have so increased and multiplied, as eventually to dispossess and supplant their captors. In 1782, Admiral Rodney took a French ship, bound for St. Domingo from Bourbon, with living plants of the cinnamon, jack-fruit and mango, sent to the botanical gardens of the former island by that of the latter. These undistinguished prizes the Admiral presented to the Jamaica Botanical Gardens.

There the cinnamon was carefully fostered, but proved to be (as it is to this day) difficult of culture in the island; whilst the mango, which was neglected, became in eleven years as common as the orange, spreading over lowlands and mountains from the sea-level to five thousand feet above it. On the abolition of slavery immense tracts of land, especially coffee estates, relapsed to a state of nature, and the mango being a favorite fruit with the blacks, its stones were flung about everywhere, giving rise to groves along the roadsides and settlements; and the fruit of these again, rolling down hill, gave rise to forests in the valleys and on their slopes. The effect of this spread of the mango has been to cover hundreds of thousands of acres, and to ameliorate the climate of what were dry and barren districts, by producing moisture and shade, and by retaining the rainfalls that had previously evaporated, besides affording food for several months of the year to both negroes and horses. It may well be, that by future generations in Jamaica, Admiral Rodney will be known less for his victory over Count Grasse, and being the first to "break the enemy's line" than as the capturer of the mango tree in the Spanish Main.

And it is the same in all countries colonized by the Anglo-Saxon; so firmly have the plants he has brought with him established their foot, or rather, roothold in the soil, that were he and all other evidence of his occupation to disappear from North

[1] *Fragaria indica* Andr. (*Potentilla durandii* Torr. and Gr.).

America, these, his fellow-emigrants, would remain as witnesses of his former presence, not only on the shores and in the forests of the older States, but in the interior prairie and the newly settled valleys of the Rocky mountains themselves.

Time does not permit me to dwell longer upon this subject of immigration during the historic period. I must now hasten to consider the flora of North America as it was for an indefinite period before the arrival of the Anglo-Saxon, embracing prehistoric and geological epochs; we have to regard this flora as a whole, and as subdivisible into local floras, characterized by the prevalence of certain assemblages of plants; to connect these local floras with the geographical features of the areas they occupy; to account for their position and composition by a reference to the countries from which their components may have been derived, and to the means of communication which exist, or may in former times have existed with these countries.

Before proceeding with this inquiry I will indicate, with the aid of the map, those prominent features of North American geography, which have regulated the distribution of its plants.

Physical Conformation of America.—In the Arctic regions the three northern continents approach, and the hydrography and geography of these regions favor the assumption that in former times they may have been connected. Next we observe that in the American continent (unlike the European and Asiatic), the great obstacles to the intermingling of floras, the mountain chains, are longitudinal; as are the principal valleys, which are the great aids to their diffusion. If we now run a section across the continent along its principal parallel (that near 40°), which approximately coincides with the isotherm of 55°, we find that it (see p. 5), represents tolerably well any other parallel to it in those meridians in which there is the greatest development of a temperate vegetation. Commencing on the east, there is first the Atlantic seaboard, bounded to the westward by mountain ranges of moderate elevation (rarely attaining 6000 feet), which under various names extend from New Brunswick, in lat. 48°, to Alabama and Georgia, in lat. 34° (and which have been collectively called the Appalachian chain). Westward of this chain are the broad, low well-watered valleys of the Ohio, Mississippi and Missouri, the latter in its intersection with our principal parallel being nearly midway across the continent and 1300 miles from the Atlantic.

From the Missouri the ascent is very gradual to the elevated region of the Rocky mountains, which consist of a complicated series of rocky ridges rarely exceeding 14,000 feet elevation, occupying a belt 300 miles broad from east to west. These ridges inclose very large, well-watered, open grassy valleys, called Parks, the rivers from which usually discharge from the range through narrow gorges, called cañons.

The parks and valleys to the east of the mountainous belt present the gray-green (grassy) vegetation of the prairie, those on the west, the hoary sage-bush (Artemisia) vegetation of the dry country to the westward; and these often intersect, so that a transverse ridge may separate a green and well-watered park from a hoary and dry one.

The descent from the Rocky mountains on the west is on to a tract elevated upwards of 4000 feet above the sea, extending for 400 miles to the foot of the Sierra Nevada. This tract is intersected by several short ranges 8000 feet high and upwards; its climate is dry, its soil saline, and many of its rivers lose themselves in salt lakes and marshes, whence the local names of Great basin, and of the Sink, Salt-lake and Desert regions. The Sierra Nevada succeeds, rising steeply to an elevation of 12,000 and sometimes of 15,000 feet. Under various names it traverses America, with little interruption, from Alaska to Southern California, at a distance of one hundred to one hundred and fifty miles from the Pacific; but its breadth is nowhere so great as that of the Rocky mountains. The descent from it to the westward is into the great valley of California, whose floor is raised but little above the sea-level, and between which and the Pacific are the low and narrow coast ranges, of which the southernmost in Southern California unites with the Sierra Nevada.

Turning now to the flora of North America north of the tropic, we find that the distribution of its plants is in remarkable conformity with its geographical and climatal features, being in meridional belts from the Arctic ocean to the gulf of Mexico; the botanical components of these belts differing more and more in advancing south, till in the principal parallel that we have traced, the diversity between the eastern and western belts is greater than between any two similarly situated regions on the globe.

Polar Area.—Commencing in the Polar area, the Arctic American flora, though on the whole a uniform one, is distinctly divisi-

ble into three; the first extends from Behring's straits to the mouth of the McKenzie river, and is marked by the presence of certain Asiatic genera and species that advance no farther eastward; the second extends thence onwards to Baffin's bay, and presents various American genera and species not found either eastward or westward of it; and the third is that of Greenland, which is almost exclusively European, and presents several anomalies which I shall hereafter discuss. Besides this eastern and western distribution of the Arctic flora, it streams southward along the three meridional mountain chains of the continent.

British North American Flora.—South of the Arctic flora is that of the British possessions, that is, of temperate America north of the 47th parallel; it consists of a mixture of North European, North Asiatic and American genera, in very different proportions, disposed in five meridional belts. 1, to the eastward, the Canadian forest region; 2, the woodless region, a continuation of the prairie region farther south; 3, the Rocky mountain region, where Mexican genera appear; 4, a dry region, a continuation of the Desert or Sink regions to the south of it; and 5, the Pacific region, which assimilates very closely in its vegetation to that of Kamtschatka.

United States Flora.—It is on entering the United States that the flora of temperate North America attains its great development of genera and species in all the meridians, and that the boundaries of the meridional belts of vegetation are most strictly defined.

I. The great eastern forest region, extending over half the continent, and consisting of mixed deciduous and evergreen trees, reaches from the Atlantic to beyond the Mississippi, dwindling away as it ascends the western feeders of that river on the prairie. It is noteworthy for the number of kinds especially of deciduous trees and shrubs that are to be found in it, even on a very limited area. Of this I shall select two examples from my journal. One was a patch of native forest a few miles from St. Louis, on the Missouri, where in a little more than half an hour, and less than a mile's walk, I saw forty kinds of timber trees,[1] including eleven of oak, two of maple, two of elm, three of ash, two of walnut, six of hickory, three of willow and one each of

[1] For the indication and names of them I am indebted to Dr. Engelmann, of St. Louis, who took me to the forest.

plane, lime, hornbeam, hop-hornbeam, laurus, drospyros, poplar, birch, mulberry and horse-chestnut; together with about half that number of shrubs.

The other example was afforded me by Goat island, which divides the great cataract of Niagara, and covers less ground than Kew Gardens. Here the vegetation was more boreal and less varied than in Missouri; but with Dr. Gray's aid I counted thirty kinds of trees, of which three were oaks and three poplars, together with nearly twenty different shrubs.

I know of no temperate region of the globe in which any approach to this aggregation of different trees and shrubs could be seen in such limited areas, and perhaps no tropical one could afford a parallel.

No less remarkable is the composition of the flora of the Eastern States. Prof. Gray has shown that most of its genera are common to Europe and Asia, but that very many are all but confined to North-eastern Asia and Western America. This generic identity, however, gives but a faint idea of the close relationship between the East American and East Asiatic, especially the Japanese, floras, for there is further specific identity in about two hundred and thirty cases, and very close representation in upwards of three hundred and fifty; and what is most curious is, that there are not a few very singular genera, of which only two species are known, one in East Asia, the other in East America; and in some of these instances the Asiatic species is a wide-spread plant in East Asia, whilst the American is an extremely scarce and local plant in its country, which with other considerations render it conceivable that the Asiatic element in East America is a dying-out one.

Leaving out of consideration the purely American genera of this flora, there remain the genera common to Europe, Asia and America; the genera confined to America and Asia; and the genera confined to America and Europe. I shall give an illustration of the proportions in which these occur by a reference to the principal trees and large shrubs only, their names being familiar to you, though the smaller shrubs and herbs afford infinitely more numerous and striking examples; thus, of those common to the three northern continents, I find in America thirty-eight genera with about one hundred and fifty species; these include maples, ashes, hollies, elms, planes, oaks, chestnuts, nut,

hornbeam, birches, alders, willows, beech, poplars, &c. Of those confined to America and East Asia I find in America thirty-three genera and fifty-five species, including magnolias, tulip tree, negundo, wistaria, Virginia creeper, gleditschia, hydrangea, liquid-amber, nyassa, tecoma, catalpa, diospyros, sassafras, benzoin, mulberry, walnut and others which, not being European, are unfamiliar to you. Lastly, of those confined to Europe and America I find only one genus, namely, the hop-hornbeam, of which there is but a single representative in each country.

Here, then, is conclusive evidence of the close botanical relationship of North-eastern Asia and Eastern North America; a relationship of which there is but little evidence in the vegetation of the prairies and Rocky mountains, and still less, perhaps, in the regions farther west.

II. The prairie region succeeds a grassy land with many peculiar herbaceous American genera, including Mexican types, of which last the most conspicuous are a yucca and cacti, which latter increase in number as the Rocky mountains are approached, where they form a noticeable feature in the landscape.

In the parks and lower valleys of the Rocky mountains, deciduous trees are few and scattered, and the forest is an open one of conifers, amongst which a pine, allied to the American nut-pines, *P. edulis*, first appears. Higher on the mountains the coniferous forests are dense, and almost the only deciduous tree is an aspen, which forms impenetrable brakes on the slopes and in the gullies. Above the forest region are the sub-alpine and alpine regions, presenting a mixture of European, Asiatic and American types.

III. Descending to the Sink region the cacti and yucca almost disappear, though they increase to a maximum farther south in this meridian. Deciduous trees are very few, and confined to the gullies of the mountains, and Mexican genera increase in numbers. The hoary sage-bush (Artemisia) covers immense tracts of dry soil, and saline plants occupy the more humid districts.

Another nut-pine of Mexican affinity (*P. monophylla*) traverses the center of this region in a narrow meridional strip, and the proportion of endemic plants, herbaceous especially, is very large.

IV. The Sierra Nevada is clothed with the most gigantic coniferous forest to be found on the globe, amongst which a very few species of deciduous trees are scattered; but none of these are

identical with trees of the eastern forests, though several are representative of them. New Mexican genera occur at all elevations from the crest of the range to its base, and thence extend across the Californian valley and the coast-ranges to the Pacific, mixed with northern West American genera and species.

In this slight outline of the botanical features of temperate and Arctic North America, I have alluded to three as most noteworthy, namely: the vegetation of Greenland, the Asiatic character of the vegetation of the eastern half of the continent, and the more southern and even Mexican character of the vegetation of the western half. How are these features to be accounted for?

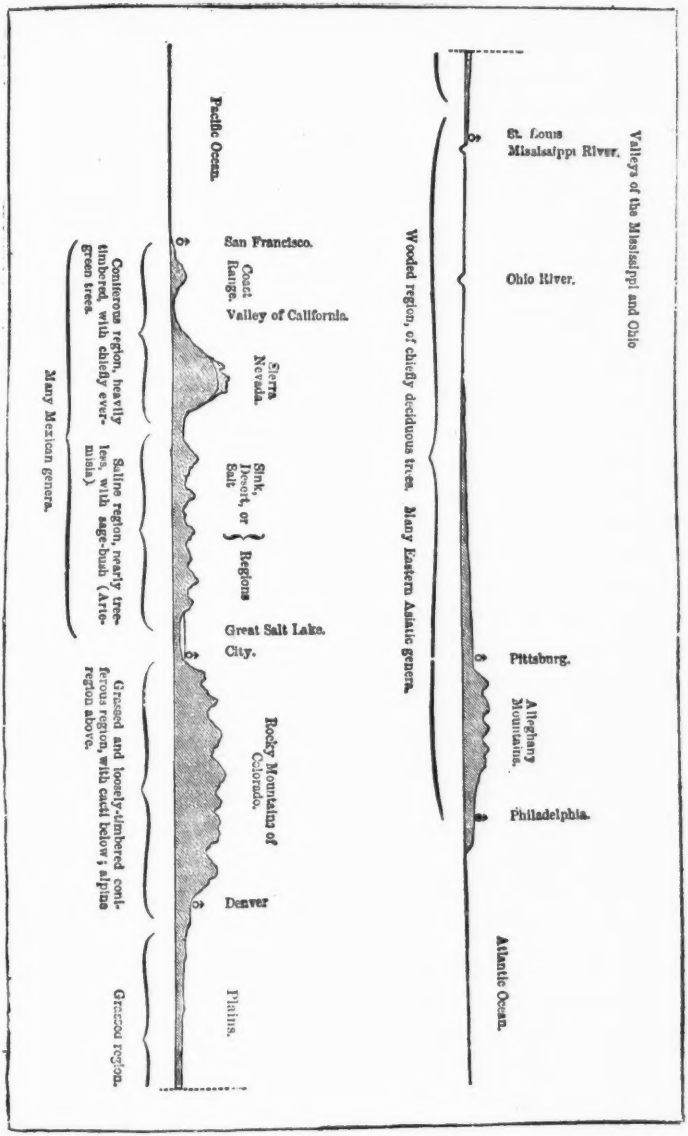
It so happened that Dr. Gray, Prof. of Botany in Harvard College (Cambridge), and I were contemporaneously, but without concert, engaged in botanical investigations which have resulted in explanations of the two first features. He was at work on the flora of Japan,[1] I on that of the Polar zone,[2] and we were both bringing to bear upon our subjects considerations regarding the variation of species which Mr. Darwin[3] almost simultaneously laid before the public, and which, I need not say, powerfully directed our studies.

The Greenland Flora.—I shall take the vegetation of Greenland first, as being first in order, though second in date of appearance and least in importance. Its chief peculiarities are: 1, that its plants are almost all of them Scandinavian (that is, North-west European), hardly any of the peculiar plants of the American arctic sea-coast and polar islands crossing Baffin's bay and Davis straits; 2, that of its three hundred flowering plants hardly any present even a variation from their Scandinavian prototypes; 3, that it is poorer in species than is any other division of the arctic flora, and wants many Scandinavian plants that are found in most other arctic countries; 4, that though Greenland extends four hundred miles south of the Arctic circle, its extra-arctic continuation adds only about one hundred species to the flora, and these

[1] "Observations upon the Relations of the Japanese Flora to that of North America, and of other parts of the North Temperate Zone." Memoirs of the American Academy of Sciences, Vol. VI, p. 377. Read December 14, 1858, and January 11, 1859.

[2] "Outlines of the Distribution of Arctic Plants." Read before the Linnæan Society of London, June 21, 1860. Trans. Linn. Soc., XXIII, p. 257.

[3] "On the Tendency of Species to form Varieties," by C. Darwin, Esq., F.R.S., and Alf. Wallace, Esq. Read July 1, 1858. Journal of the Proceedings of the Linnæan Society of London, Vol. III (Zoölogy), p. 45.



Section of North American Continent in about Lat. 40°.

all cross the Arctic circle in other longitudes; 5, some Greenland species are confined to it and to the mountains on the Atlantic

side of America, being found nowhere else in Arctic or Sub-arctic America.

My explanation of these anomalies was, that at a period previous to the glacial, a flora common to Scandinavia and Greenland was spread over the American polar area, and that on the accession of the cold of that period this flora was driven southwards, and was affected differently in different longitudes. In Greenland many species were exterminated, being as it were driven into the sea at the southern extremity of the peninsula, where only the hardiest survived. On the return of warmth the Greenland survivors migrated northward, peopling the peninsula with the hardiest of the species of its former flora, unmixed with American species; and unchanged in aspect from never having been brought into competition with those of any other flora. On the other hand, the same Scandinavian plants when driven south on the plains of the continent multiplied there in individuals, and being brought into competition with American species descending from the continental mountains on to the plains, assumed varietal forms. On the return of warmth, therefore, many Scandinavian species that had been exterminated in Greenland would, having survived on the continent, travel northwards on it, some unchanged, others under varietal forms, accompanied with the American species that had descended from the mountains during the cooling of the continent. Lastly, as some of the Scandinavian species were no doubt local, and confined to near the meridian of Greenland, it is not surprising to find that a few such should survive only in Greenland and on the eastern alps of North America.

Thus only could I satisfactorily account for the almost complete identity of the Greenland flora with the Scandinavian after such changed conditions of climate; for the paucity of its species; for the absence in it of varieties; for the rarity in it of peculiarly American species; for the few species which extra-arctic Greenland adds to its arctic flora; and for certain of its plants being limited in range to Greenland and the eastern American alps.

North Asiatic and North American Floras.—The relationship between the flora of North-east Asia and Eastern North America has been fully explained by Dr. Asa Gray in an essay on the flora of Japan, which is the first entirely satisfactory contribution of its kind to the science of botanical geography known to me.

After a detailed comparison of the botany of Japan and North America, and proving their affinity, Prof. Gray refers to the fact that many of the existing genera and even species of both floras coëxisted in the high latitudes of America during Miocene times, as shown by Heer and other palæontologists; during which period he further assumes that the three northern continents were conjoined, or so nearly contiguous as to allow of a commingling of their floras.

The glacial period followed, carrying an arctic climate south to the latitude of the Ohio, but so gradually, that these plants were not exterminated, but wholly or in part driven southward, followed in the rear by the arctic vegetation. As the temperature rose with the retreating ice, this flora returned northward, leaving the arctic and sub-arctic plants on the mountains of both East and West America.

He next shows that the retreat northward was to a somewhat higher latitude than the same plants now attain; and this he accounts for by a reference to the fluvial epoch of Dana,[1] when the region of the great lakes was submerged five hundred feet below their present level. This diminished area and lowered elevation of the land, by inducing a milder climate than now obtains in the lake region, favored the extension of the flora to a higher latitude than it now attains, and hence effected a second commingling of American and Asiatic plants. Lastly, Dana's Terrace epoch supervened, when the previously depressed northern region was again raised, cooling the climate, finally dissociating the Asiatic and American floras, and giving to the arctic and sub-arctic plants of the continent their present limits.

It remains now to account for the great rarity of East Asiatic types in America west of the prairies, and the presence in those meridians of Mexican and still more southern ones. Hitherto there have been no other attempts at a solution of this problem than such unsupported speculations as that the western half of the continent, though so much the loftier, was submerged during the southern migration of the northern miocene plants; or that the climate of the West was unsuited to the habits of these, which

[1] Whilst these pages were still in the press, Prof. Gray has informed me that he now lays little stress on the conditions supposed to be due to the terrace and fluvial epochs; and that he is rather disposed to consider the separation of the northern floras by the Glacial epoch to have been final.

appears to me to be at variance with the fact that when imported into it they thrive luxuriantly.

The explanation which I have to offer will be best understood by a reference to the section (p. 163), which shows the western half of the continent to be enormously elevated as compared with the eastern, and to have been singularly adapted for the retention of vast bodies of ice for long after the Glacial period. We find there a valley (the desert region), upwards of four hundred miles broad, and upwards of four thousand feet elevation, with many ranges of over eight thousand feet in it, bounded by broad and lofty mountains, together occupying at least two-thirds of the breadth of the western half of the continent. We further know that these mountains were clothed with ice during the Glacial epoch, and that the valley was then occupied by a vast lake; for on the uppermost of the many shelves which the retiring waters of this lake cut on the flanks of the Rocky mountains and Sierra Nevada, the skull of the musk-ox, the most arctic of land quadrupeds, has been found.

It is obvious that this whole western region must have retained its glacial mantle for an incalculable period after Eastern America had been sufficiently warmed to admit of the northward return of the plants that had been driven southward in it; and that this glaciated condition must have effectually barred a similar return of the same plants in those western meridians, these must have perished, in short, on reaching Southern California. Long ages after, when the western ice disappeared, and the climate of the valleys warmed, the Mexican and more southern plants would, as a matter of course, take possession of the unoccupied soil, and advance northward till they encountered the boreal vegetation of North-western America, with which they now commingle.

I have said that the extinction of East Asiatic types in Western America was not total; a few escapes are found in the valleys of the Rocky mountains and Sierra Nevada,[1] and also along the coast of the Pacific, the warming influence of which favored their preservation during the northern migration.

The Sequoias.—Two instances of these escapes are of such interest that I shall, in concluding this lecture, bring them under your

[1] And also on the highlands of Central Mexico, where some Asiatic types remain which have not migrated farther north or south in America. Such are the eminently Asiatic genera Bocconia, Meliosma, Photinia, Cotoneaster, Deutzia and Abelia.

notice; they are those giants of the vegetable kingdom, the Sequoias, the red-wood (*S. sempervirens*), and the "big-tree" or "Wellingtonia" (*S. gigantea*).

The fossil remains of these trees, or species most closely allied to them, are found in Miocene beds in high latitudes all round the globe; in Vancouver's island, Sitka, on the arctic American sea-coast, in Greenland, Spitzbergen and in arctic Asia, &c. The genus, therefore, which first appeared in the Cretaceous times, was undoubtedly a member of that mixed Americano-Asiatic flora that was driven southward during the Glacial period. The genus is now confined to Western North America, and to the two above-named species, but it is represented in Eastern America by the very closely allied genus Taxodium, and in Eastern Asia by Glyptostrobus.

The distribution of the two Sequoias is most instructive. The red-wood forms a dense narrow forest tract for about five hundred miles, skirting the ocean, along whose warmer shore it crept northward after the Glacial epoch. It rivals in height its sister of the Sierra, and attains an enormous girth and age, though I can find no account of any attempt having been made to estimate its age.

The *S. gigantea*, or "big-tree" (the Wellingtonia of British gardens), again, is a plant of a cooler climate; and hence, having survived the glacial cold, was enabled to establish itself in the Sierra Nevada under certain very restricted conditions. It extends at intervals along the western slope of the Sierra to a little north and south of the parallels of 36° and 38° N., that is, for nearly two hundred miles in a north-west and south-east direction, at elevations of five thousand to eight thousand feet above the sea. Towards the north the trees occur as very small, isolated, remote groves of a few hundreds each, most of them old and interspersed amongst gigantic pines, spruces and firs, which appear as if encroaching upon them; such are the groves visited by tourists (Calaveras, Mariposa, &c.). To the south, on the contrary, the big-trees form a colossal forest, forty miles long and three to ten broad, whose continuity is broken only by the deep sheer-walled cañons that intersect the mountains; here they displace all other trees, and are described as rearing to the sky their massive crowns; whilst seen from a distance the forest presents the appearance of green waves of vegetation, gracefully following the com-

plicated topography of the ridges and river basins which it clothes.

But by far the most remarkable fact hitherto reported regarding the disposition of the groves is, that they occupy only those spots in the Sierra which were first laid bare when its icy mantle became broken up into isolated glaciers. Thus, commencing at the north, the gap of forty miles between the Calaveras and Tuolomne groves was occupied by the great glacier of the Tuolomne and Stanislaus rivers; that between the Merced and Mariposa groves by the glacier of the Merced river, which sculptured the famous Yosemite valley; and so on—each successive group of trees occupying a lofty spur between the sites of ancient glaciers, and the greatest continuous extension of the forest (of forty miles) occurring exactly where, owing to the topographical peculiarities of the region, the ground was most perfectly protected from great fields of ice.

Mr. Muir, a very intelligent and accurate observer, who has studied the groves throughout their length and breadth most diligently,[1] and to whom I am indebted for the above and much other information regarding the southern forest of Big-trees, considers that these have never since the Glacial epoch been more widely distributed or in greater vigor than now, and doubts, indeed, if the forests have reached their prime, founding his opinion on the high state of health of the mass of the trees, the multitude of seedlings and saplings in the southern groves, and the absence of any trace of trees having existed outside the present limits of the groves (as of dead trees, stumps, or the great holes left by fallen trees).

Size of the Big Trees.—So little that is trustworthy has hitherto been published regarding the age, size and durability of the Big-tree trunks when fallen, that I shall offer you some accurate data which I obtained on these points chiefly from Mr. Muir. A tree felled in 1875 had no appearance of age, it was 69 feet in girth inside the bark, and the number of annual rings counted by three persons varied between 2125 and 2139. Another was 107 feet in girth inside the bark at four feet from the ground; its wood was very compact, and showed, throughout a considerable portion of the

[1] "On the Post-Glacial History of *Sequoia gigantea*," by John Muir, of San Francisco, Cal. Proceedings of the Amer. Assoc. for the Advancement of Science, Buffalo meeting, Aug., 1876.

trunk thirty annular rings to the inch. This, if the rings were of uniform diameter in the rest of the trunk, would give the incredible age of 6400 years; but as the interior rings of such trees are much broader than the outer, half that number to the inch is a more conceivable estimate, which would give an age of 3200 years. The only other instance of careful counting of rings which I can find is that of the felled tree in the Calaveras grove, which measured seventy feet girth inside the bark at six feet above the ground, and which at forty feet above the ground had 1255 rings. In this case the rings next the bark were thirty-three to the inch, a number which at five feet inward had diminished one-half. The result of many measurements, chiefly by Prof. Whitney,[1] gives, as the average height of full-grown trees, 275 feet, and a maximum a little over 320; a girth outside the bark, at six feet above the ground, of seventy, with a maximum of 120; whilst the maximum age possibly attained may be 4000 years, though this is very improbable.

The duration of the dead wood in the forest is very great. I rarely observed signs of rot in the fallen trees I examined, whilst in similar forests in North California I saw gigantic trunks of silver firs forming mounds of rotten *débris* without an atom of sound wood, and this in two years after their fall, as I was assured. I had no data for ascertaining the length of time during which any of the prostrate Sequoia trunks which I saw may have lain on the ground, but Mr. Muir has supplied me with a very crucial case. It is that of a prostrate trunk with no signs of decay in any part of it, which had been burnt in two by a forest fire, and in the trench between the severed portions of which a silver fir grew. This fir was felled, and had 380 annual rings; therefore, to estimate the time during which the Sequoia trunk had lain uninjured, we must add to the 380 years, first the time it lay before the forest fire burnt it in two, and then the unknown interval between that time and the arrival of the silver fir seed.

The millenia during which these Sequoia trees must have remained *in statuo quo*, proving the long duration of existing conditions of climate, are but as minutes compared with the time occupied by the migration of this very species, or its ancestors,

[1] Very careful measurements of the trees in the Calaveras and Mariposa groves are given by Prof. Whitney (State Geologist) in the Yosemite Guide-Book, published under the authority of the Geological Survey of California (1874).

north and south in the continent of America. Whatever might otherwise be the extent of the Sequoia's travels, they are now at an end. Man has pronounced the sentence, "Thus far shalt thou go, and no farther!" The doom of these noble groves is sealed. No less than five saw-mills have recently been established in the most luxuriant of them, and one of these mills alone cut in 1875 two millions feet of Big-tree lumber; and a company has lately been formed to cut another grove. In the operations of the California wood-cutters the waste is prodigious. The young, manageable trees are first felled; after which the forest is fired to clear the ground and get others out, and thus the saplings are destroyed. More destructive still are the operations of the sheep-farmers, who fire the herbage to improve the grazing, and whose flocks of tens of thousands of sheep devour every green thing, and more effectually than the locust. The devastation of the California forest is proceeding at a rate which is utterly incredible, except to an eye witness. It is true that a few of the most insignificant groves of the Big-trees at the northern extreme of its range are protected by the State Legislature, and that a law has been enacted forbidding the felling of trees over fifteen feet in diameter, but there is no law to prevent the cutting or burning of the saplings, on which the perpetuation of the grove depends, or to prevent the burning of the old trees, which, if they do escape the fire, will succumb to the drought which the sweeping away of the environing forest will occasion.

During the last quarter of a century the Anglo-Saxon has been ruthlessly carrying fire and the saw into the forests of California, destroying what he could not use, and sparing neither young nor old, and before a century is out the two Sequoias may be known only as herbarium specimens and garden ornaments; indeed, with regard to the Big-tree, the noblest of the noble coniferous race, the present generation, which has actually witnessed its discovery, may live to say of it, that "The place which knew it shall know it no more."

THE ORIGIN OF THE SPECIALIZED TEETH OF THE CARNIVORA.

BY E. D. COPE.

THE specially developed teeth of the Carnivora are the canines and sectorials. The former are large in many orders of *Mammalia*, and their origin is probably to be sought among the Theromorphous reptilia,[1] as *Clepsydrops* and *Deuterosaurus*, if not in still lower types. The successive modifications of form which have resulted in the existing specialized single sectorial tooth of the *Felidæ* have been already pointed out.[2] They were shown to consist in the gradual obliteration of the internal and posterior tubercles and the enlargement of the external anterior tubercle in connection with an additional anterior tubercle. The modification in the character of the dentition taken as a whole, was shown to consist in the reduction in the number of teeth, including the sectorials, until in *Felis*, etc., we have almost the entire function of the molar series confined to a single large sectorial in each jaw.

Observation on the movements of the jaws of Carnivora shows that they produce a shearing motion of the inferior on the superior teeth. This is quite distinct from the sub-horizontal movement of Ruminants, or the vertical motion of hogs and monkeys. Examination of the crowns of the sectorials shows that the inner side of the superior, and the external side of the inferior, are worn in the process of mastication. The attempt to cut the tough and stringy substances found in animal bodies, is best accomplished by the shearing of the outer edge of the lower molar on the inner edge of the external tubercles of the superior molar in an animal with simple tubercular teeth. The width of the mandible is too great to allow the inferior teeth to shear on the inner edge of the inner tubercles of the superior series. The cusps of both superior and inferior teeth engaged in this process, have developed in elevation, at the expense of those not engaged in it, viz: the internal cusps of the same teeth. The atrophy of the latter cannot have been due to friction, since the internal cusps of the inferior series which have not been subjected to it, are reduced like those of the superior sectorial, which have. Indeed, it is possible that some of the *Creodonta*, the carnivores of

[1] American Naturalist 1878 p. 829.

[2] Cope, Proceedings Academy Philada., 1865, p. 22.

Y 1875 p 20

the lower Eocene, may have been derived from ancestors without or with rudimental inner cusps. In any case the effect of use in lengthening the cusps appears to have operated in the Carnivora, as it has done to a greater degree in the *Ungulata;* and the lateral vertical wear would appear to have resulted in the blade-form, as transverse wear in the Ungulates has resulted in the plane grinding surface.

The specialization of one tooth to the exclusion of others as a sectorial, appears to be due to the following causes. It is to be observed in the first place that when a carnivore devours a carcass, it cuts off masses with its sectorials, using them as shears. In so doing it brings the part to be divided to the angle or canthus of the soft walls of the mouth, which is at the front of the masseter muscle. At this point, the greatest amount of force is gained, since the weight is thus brought immediately to the power, which would not be the case were the sectorial situated much in front of the masseter. On the other hand the sectorial could not be situated farther back, since it would then be inaccessible to a carcass or mass too large to be taken into the mouth.

The position of the sectorial tooth being thus shown to be dependent on that of the masseter muscle, it remains to ascertain a probable cause for the relation of the latter to the dental series in modern Carnivora. Why, for instance, were not the last molars modified into sectorial teeth in these animals, as in the extinct *Hyaenodon*, and various *Creodonta*. The answer obviously is to be found in the development of the prehensile character of the canine teeth. It is probable that the gape of the mouth in the Hyaenodons, was very wide, since the masseter was situated relatively far posteriorly. In such an animal the anterior parts of the jaws with the canines had little prehensile power, as their form and anterior direction also indicates. They doubtless snapped rather than lacerated their enemies. The same habit is seen in the existing dogs, whose long jaws do not permit the lacerating power of the canines of the *Felidæ*, though more effective in this respect than those of the *Hyaenodons*. The usefulness of a lever of the third kind, depends on the approximation of the power to the weight; that is, in the present case, the more anterior the position of the masseter muscle, the more effective the canine teeth. Hence it appears that the relation of this muscle to the inferior dental series depended originally on the use of

the canines as prehensile and lacerating organs, and that its insertion has advanced from behind forwards in the history of carnivorous types. Thus it is that the only accessible molars, the fourth above and the fifth below, have become specialized as sectorials, while the fifth, sixth, and seventh have, firstly, remained tubercular as in the dogs, or, secondly, have been lost, as in hyænas and cats.

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GRIEF IN THE CHIMPANZEE.

BY ARTHUR E. BROWN.

SOME months ago I called attention in the "Notes" of the NATURALIST to several evidences of a high degree of mental power on the part of the chimpanzee. One of the pair which, at that time, was in the Philadelphia Zoological Garden, has since died, and the behavior of the surviving one on that occasion appears to me to bear somewhat on the acquired nature of the physical means by which our strongly excited emotions find relief, as well as on the origin of those emotions themselves.

Among the lower animals, with the exception of some domesticated varieties, any striking display of grief at the death or separation from an animal to the companionship of which they had been accustomed, has rarely been observed, and although a few statements of such occurences have been made by different authorities, it is probable that the feeling of individual association, or friendship—if the term may be so used—partakes too much of an abstract nature to be sufficiently developed in them to retain much of a place in memory when the immediate association be once past. This would seem to be the case even in one of the strongest of animal attachments—the maternal instinct—in which the direct presence of the offspring, acting as a stimulus, calls forth the emotion of the mother, which, strongly rooted as it appears to be, contains much of a reflex nature and ceases on the disappearance of its cause. And here let it be said, that although the instinct of maternity and the sentiment of friendship perhaps differ widely in their origin, yet in their manifestations they are so nearly alike that the reverse feelings excited by any violence done to them, need not and probably do not differ much in kind.

With the chimpanzee, the evidences of a certain degree of genuine grief were well marked. The two animals had lived together

for many months, and were much attached to each other; they were seldom apart and generally had their arms about each other's neck; they never quarreled, even over a pretended display of partiality by their keeper in feeding them, and if occasion required one to be handled with any degree of force, the other was always prepared to do battle in its behalf on the first cry of fright. After the death of the female, which took place early in the morning, the remaining one made many attempts to rouse her, and when he found this to be impossible his rage and grief were painful to witness. Tearing the hair, or rather snatching at the short hair on his head, was always one of his common expressions of extreme anger, and was now largely indulged in, but the ordinary yell of rage which he set up at first, finally changed to a cry which the keeper of the animals assures me he had never heard before, and which would be most nearly represented by *hah–ah–ah–ah–ah*, uttered somewhat under the breath, and with a plaintive sound like a moan. With this he made repeated efforts to arouse her, lifting up her head and hands, pushing her violently and rolling her over. After her body was removed from the cage—a proceeding which he violently opposed—he became more quiet, and remained so as long as his keeper was with him, but catching sight of the body once when the door was opened and again when it was carried past the front of the cage, he became violent, and cried for the rest of the day. The day following, he sat still most of the time and moaned continuously—this gradually passed away, however, and from that time he has only manifested a sense of a change in his surroundings by a more devoted attachment to his keeper, and a longer fit of anger when he leaves him. On these occasions it is curious to observe that the plaintive cry first heard when the female died, is frequently, though not always made use of, and when present, is heard towards the close of the fit of anger. It may well be that this sound having been specialized as a note of grief, and in this case never having previously been called into use by the occurrence of its proper emotion, now finds expression on the return of even the lesser degree of the same feeling given rise to by the absence of his keeper, and follows the first outbreak of rage in the same manner as the sobbing of a child is the natural sequence of a passionate fit of crying. It may be noted too, that as his attachment to his keeper is evidently stronger than when there was another to divide with him

the attention which they received, the grief now caused by the man's absence would naturally be much stronger and a more exact representation of the gestures of grief would be made.

Notwithstanding the intensity of his sorrow at first, it seems sufficiently evident that now a vivid recollection of the nature of the past association is not present. To test this a mirror was placed before him, with the expectation that on seeing a figure so exactly like his lost mate, some of the customary signs of recognition would take place, but even by caressing and pretending to feed the figure in the glass, not a trace of the expected feeling could be excited. In fact, the only visible indication of a change of circumstances is that while the two of them were accustomed to sleep at night in each other's arms on a blanket on the floor, which they moved from place to place to suit their convenience, since the death of the one, the other has invariably slept on a cross-beam at the top of the cage, returning to inherited habit and showing, probably, that the apprehension of unseen dangers has been heightened by his sense of loneliness.

On looking over the field of animal emotion it seems evident that any high degree of permanence in grief of this nature belongs only to man; slight indications of its persistence in memory are visible in some of the higher animals and domesticated races, but in most of them the feeling appears to be excited only by the failure of the inanimate body, while present to the sight, to perform the accustomed actions.

The foundation of the sentiment of grief is probably in a perception of loss sustained in being deprived of services which had been of use. An unrestrained indulgence in an emotion so powerful as this has become in its higher forms, would undoubtedly prevent due attention to the bodily necessities of the animal subjected to it; in man, its prostrating effects are mainly counteracted by an intelligent recognition of the desirability of repairing the injury suffered, and in him, therefore, the feeling may exist without serious detriment to his welfare, but among the lower animals it would seem probable that any tendency to its development would be checked by its own destructive effects—the feeling, for instance, would most frequently occur on the death of a mate—a deep and lasting grief would then tend to prevent a new association of like nature and would thus impede the performance of the first function of an animal in its relation to its kind—that of reproduction.

EXPERIMENTS WITH PYRETHREUM ROSEUM IN KILLING INSECTS.

BY W. L. CARPENTER, U.S.A.

IN the August number of the AMERICAN NATURALIST appeared an article on the carpet-beetle, by J. A. Lintner, in which the statement was made, as nearly as I can now remember, that "although he had never used *Pyrethrum roseum* as an insect exterminator, he had no doubt that it would prove unavailing if applied to the destruction of the *Anthrenus*." As it seemed unfair to condemn without a trial what is generally regarded as a useful insect poison, I resolved to test it experimentally; and now present the result of several trials with different orders of insects.

The insects were placed under a tumbler, which was slightly raised to admit fresh air, and a small quantity of the *Pyrethreum roseum*, or Persian Insect Powder of commerce, introduced on the point of a pen-knife. The movements of the insects brought them in contact with the powder, which readily adhered to the body; in attempting to remove it from their appendages a few particles would be carried to the mouth and thus incorporated in the juices of the stomach with fatal effect.

A honey-bee became perfectly helpless in fifteen minutes, a mud-wasp in eight minutes, a small species of ant in five minutes; a small species of *Pyralidæ* became helpless in twenty minutes; the large *Papilio asterias* resisted the effects of the drug for over one hour, and upon being released seemed to recover, but died next day. A larva of one of the *Noctuelitæ* did not seem susceptible, its jaws were repeatedly filled with the powder, which it invariably ejected by throwing out its juices; at the end of two hours it was still able to crawl feebly. A house-fly became helpless in ten minutes, a mosquito in fifteen minutes, a flea in three minutes.

In experimenting upon the *Coleoptera*, an insect as nearly the size of the carpet-beetle as could be found was secured in *Diabrotica duodecim-punctata*, an abundant species here. It was easily affected and became helpless in twelve minutes. A small pinch placed in the jaws of a large *Carabus* stopped locomotion in thirty minutes. The *Hemiptera*, owing to their peculiarly shaped mouths, were enabled to vigorously resist the baleful influence.

A species of *Coreus* was active at the end of two hours, but was ultimately overcome. A large sized katydid was deprived of motion at the end of ten minutes; *Caloptenus spretus* likewise in eighteen minutes. A dragon-fly (*Libellulidæ*) died in one hour. Spiders succumbed in one hour and fifteen minutes. The scent from the powder did not produce any bad effect upon insects subjected to its odor where actual contact was not possible. But when caried to the maxillæ or mandibles, the effect is to produce complete paralysis of the motor nerves. The legs are paralyzed in regular order, commencing with the first pair; insects will sometimes live for days in this condition, but death ultimately results from the introduction into the mouth of the smallest quantity. These experiments prove that all insects having open mouth parts are peculiarly susceptible to this powerful drug. And as a result, the writer does not hesitate to recommend the powder to housekeepers as an infallible agent in destroying the carpet-beetle and preventing its ravages. Twenty-five cents' worth of powder liberally sprinkled upon the floor before putting down a carpet, and afterward freely placed around the edges and never swept away, will suffice to preserve a large sized carpet. No ill effects from its use need be feared by the household, since if applied in this way it will be only poisonous to all kinds of insects.

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VALENTINE.

BY F. E. W.

APPLE buds and blossoms bourgeon
  All the hill-side over;
Rare and sweet the pledge and presage
  Nature gives her lover.

Buds will blossom, blossoms wither
  In the summer's sun;
Trees will blush with rosy fruitage
  When the summer's done.

Harvest-time will come and gather
  Fruits and yellow sheaves;
Bud and flower and fruit will vanish;
  Left to us, the leaves!

Leaves or blossoms—what doth matter?
Phases of one thought;
Leaf in spring is fruit in autumn,
Bud-and-blossom bought.

Earth has tree and fruit within it;
Life and thought, the clod;
Stones spring up to love and duty
From the sun-kissed sod.

February 14th.

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RECENT LITERATURE.

COMSTOCK'S OUTLINE OF GENERAL GEOLOGY.[1]—This neat little volume of 80 duodecimo pages, is peculiar and interesting, as it occupies a novel position among the many aids now furnished to the student of this most comprehensive branch of physical science. In his brief preface, the author explains its character, as an amplified syllabus of his elementary lectures to a mixed class in the University, who are required to gain a general familiarity with the facts and principles of geology, before they can enter either of the more extended courses, on Palæontology and on Economic Geology, given at Cornell. It is designed as a handbook of classified statements and references, to be used in connection with lectures on the one hand and with collateral reading on the other; and a blank leaf is bound in between every two pages of text, for diagrams, memoranda, etc. The general arrangement of topics is similar to that of Dana's Manual, save that Dynamical Geology precedes Historical. Under each minor division, is given an exceedingly concise statement of the facts and laws of that part of the subject, as recognized by the best authorities, and generally also a brief notice of other or older views. This is followed by a series of references, made by numeral figures, to the Reference List at the close of the book, in which about one hundred and fifty works, both general and special, including articles in scientific periodicals, monographs, etc., of particular value, are arranged, frequently with a few words of estimate, guidance, or caution, for the student.

It will readily appear, from the mere statement thus given, that the hand-book of Prof. Comstock's has great value, if only for its references, apart from its condensed and carefully classified summaries of fact. As stated in the preface, some parts of the subject are treated more fully than others. We may instance the

[1] *An Outline of General Geology*, with copious references. Designed for the use of both general and special students. By THEODORE B. COMSTOCK, B.Ag., B.S., in charge of the Department of Geology, Palæontology and Economic Geology, in the Cornell University. Ithaca, N. Y.: University Press, 1878.

section on Heat as a geological agent, Prof. Comstock's classification of Igneous and Metamorphic rocks, that on Tertiary mammals, and the closing section, upon Prehistoric Archæology. But the general scope and adaptation of the work are excellent, if its purpose be borne in mind; viz., to aid the student in holding together the knowledge gained from books and lectures, until in the course of time and practice, it can grow up into a connected system in his own mind, and become a permanent possession. It would be easy to point out things that might be added; but were the work enlarged much, it would lose the character which it now has, of an "Outline," and become what it is not designed for, a text-book. Prof. Comstock deserves great credit in our judgment, for so good and careful a presentation of the principal facts and laws of his department, prepared under great stress of professional labors at the University, in the sadly vacant place of the lamented Hartt. In his preface, he speaks of his hesitation, from conscious imperfections, in seeking for the work a wider field than his own lecture room; but he hopes still, that it may prove of service to some other teachers and students. He has done well in giving it the possibility of this wider circulation; and we cannot but think that many will thank him for having done so. We would advise any student who means to be systematic and comprehensive, and any teacher or young professor who would do justice to his work, to procure this little book without delay.—D. S. M.

GEGENBAUR'S ELEMENTS OF COMPARATIVE ANATOMY.[1]—This book marks an epoch in comparative anatomy, since the subject is not treated in the manner of the older works, such as those of Cuvier, Owen, and even Huxley, inasmuch as the facts concerning the comparative structure of the different organs of animals are not presented in a simply comparative manner ascending from the mere simple to the complex, but the author goes a step beyond his predecessors, and uses his array of facts as a foundation for a theory that may explain why the more complex structures have such a constant relation to the simpler. The facts recorded in this work are vitalized and interpenetrated by the principles of the theory of decent. To some this will be the main fault of Gegenbaur's work, to others, the introduction of a speculative and hypothetical thread, weaving all the facts into a connected, logical system, will enhance the value of the treatise. At all events it is time an effort should be made to combine the facts of comparative anatomy into a harmonious system, and if the hypothe-

[1] *Elements of Comparative Anatomy.* By CARL GEGENBAUR, Professor of Anatomy and Director of the Anatomical Institute, at Heidleberg. Translated by F. JEFFREY BELL, B.A., Magdalen College, Oxford. The Translation revised and a Preface written by E. RAY LANKESTER, M.A., F.R.S., Fellow of Exeter College, Oxford, and Professor of Zoölogy and Comparative Anatomy, in University College, London: Macmillan & Co., 1878, 8vo., pp. 645. $7.00.

sis used to connect the facts is true to and explains them, then the honor is due to the eminent author. At any rate until the theory of descent is cast aside as useless and erroneous, the science of Comparative Anatomy, hitherto so unwieldly and overgrown with isolated data, must be thus simplified and vivified.

The student will not find the book easy reading, and he should not take it up until he has mastered books like Siebold's admirable Comparative Anatomy of the Invertebrates, Rolleston's Forms of Animal Life, Huxley's Anatomy of the Invertebrates and Vertebrates, and some good work on human anatomy. He will then be able to appreciate the theory of the origin of vertebrate limbs from the fins of fishes, and to understand Gegenbaur's theory of the skull, which will supplant, and indeed has already, Oken's, Gœthe's and Owen's views based on the consideration of the skulls of the highly specialized bony fishes and mammals. The origin and specialization of the vertebrate column is also discussed in a clear and simple way, most valuable to the student, and so the formation of the different organs of special sense, the ear, eye and nose, as well as the rise and development of the brain.

We would especially recommend teachers of zoölogy, comparative anatomy and human anatomy to earnestly study this book, as it will aid in the difficult work of presenting the leading principles of animal morphology in a simple, condensed, logical way.

This English translation, which is on the whole well done, for the German of the original is difficult to translate, has appeared nearly contemporaneously with the improved second German edition. Gegenbaur has in this edition, removed the Brachiopoda from the Mollusca, and treated them as an independent "Phylum," equivalent to the Mollusca or Vertebrata, thus paying a silent compliment to our countryman, Morse. The Tunicates also stand as an independent Phylum or Branch. The sponges are still united with the Cœlenterates, a place which they may not hold in subsequent editions. The illustrations are choice, the typography excellent, and we would recommend the work as the most stimulating, suggestive and philosophical treastise the advanced student can find.

SCHMARDA'S ZOÖLOGY.[1]—This is on the whole an excellent compendium of zoölogy, valuable for the lengthy introductory matter, relating to the following subjects in general zöology; inorganic and organic substances, statics and dynamics of formed material, histology, physiology, development, psychology, the geographical distribution of animals, methods of study, and the principles of zoölogical classification. The systematic portion begins with the lowest Branches and ascends to the highest, the author

[1] *Zoölogie.* Von LUDWIG K. SCHMARDA. Zweite umgearbeitete Auflage. I. Band. mit 324 Holzschnitten, 1877. II. Band. mit 385 Holzschnitten, 1878. Wien. 8vo, pp. 486, 727.

adopting seven "Divisions" or Branches, *i. e.*, the *Protozoa*, *Cœlenterata*, *Echinodermata*, *Vermes*, *Condylopoda* (Arthropoda), *Mollusca*, and *Vertebrata*.

The illustrations are numerous, very well engraved and printed, and most of them seem original and expressly designed for this work. The bibliography is full enough for the purposes of the work, and there is a voluminous index. The presswork, and paper, and wood cutting is above the average of work done in Vienna.

CONGRESSIONAL RECORD, FEB. 12.—GEN. GARFIELD ON GOVERNMENT SURVEYS.—The remarks of Gen. Garfield before the House of Representatives in committee on Tuesday last, on the subject of the United States Geological surveys, deserve notice. This is especially due, because Gen. Garfield has always been friendly to the scientific enterprises of our government. But on this occasion he presents himself in a different light, for while not desiring to be thought to be attacking the surveys, he really places himself in opposition to the essential basis of their work, viz., pure science. He seems to entertain the idea that pure science is one thing, and economic science another; and that while the government may encourage the latter by pecuniary aid, it should not assist the former. Now it cannot be too strongly insisted that the two things here distinguished, are one and inseparable, and that economic science is largely pure science applied to practice, and that without pure science, it could not exist. For instance, a most important aid to mining prosperity is geology; but geology cannot exist without paleontology; yet paleontology must be regarded as in itself inapplicable to human economy. But on this science rests the determination and identification of rock strata everywhere. Now paleontology is itself impossible without zoölogy, a science of all others generally esteemed the most useless. Gen. Garfield's distinction is impossible. It is true that the General may derive some aid and comfort from Maj. Powell's report to the Secretary of the Interior, on the subject of the surveys, but the sentiments of that document are condemned by the scientific men of the country.

Gen. Garfield then says that science like religion should be left to be developed by "the people," and that government support works the same kind of injury to scientific progress that it does to religion. He then goes on to employ the following remarkable expressions: "Generally the desire of our scientific men is to be let alone * * and not to have the government enter the lists as the rival of private enterprise." "* I believe we have spent a large sum of that money upon an unwise system, and in a way which has tended to discourage the private pursuit of science by our people. We have made the government a formidable and crushing competitor of private students of science **." We suspect that such views will astonish the scientific men

of the country. They are certainly beyond precedent extraordinary. The difference between state support for religion and science is world-wide. Theology is matter of opinion, and as such governments cannot interfere with it; science is matter of fact, and in so far as it is fact of vital importance, it is the business of governments to develop it as they are bound to see that ignorance and illiteracy do not prevail among their people. And it is not always appreciated, in view of the amount of knowledge that has been developed in the world, how little of it touches as yet, the deepest problems of human life, and how much therefore remains to be done. It should also be remembered that our educational system depends for its supply of fact on the labors of scientific men; and that therefore government aid cannot be more judiciously expended than in enabling scientific men to bring forth their results.

We deny squarely that there is any such rivalry as Gen. Garfield imagines to exist between the government and the private student. Rivalry there may be between individuals, but as these pursuits do not yield pecuniary rewards, but are for the public good, such rivalry is beneficial, and should be encouraged. As to the supposition implied by Gen. Garfield's remarks, that government aid gives a presumption in favor of the views of scientists employed by government, it is quite out of the question, and indicates a wrong apprehension of the spirit of science. In this field every man's work stands on its own merits, no matter who or where he be. The idea that any scientific man deprecates government aid to science, is as false as it new. The idea of government being a "formidable and crushing competitor" of science, is very curious. Who could have originated such a thought we cannot conceive, unless it be some pseudoscientist whose estimate of scientific reputation is determined by the official position a man holds, rather than by the quality of the work he does. Most preposterous of all is the remark that aid from government has tended to discourage private pursuit of science by our people! We venture to say that our government surveys have done more to *encourage* the pursuit of science by our people than all other causes combined. It has not only encouraged it in this country, but in Europe, so effectively have the surveys been conducted. The desire of the people for their publications is such that the editions are never large enough to supply the demand. The students of science everywhere regard them as one of the grandest features of our country and time.

But Gen. Garfield has not escaped self-contradiction. He is in favor of government aid to "inquiries which in consequence of their great magnitude and cost cannot be successfully made by private individuals." Here the honorable member reaches the kernel of the matter. It is precisely enterprises of the kind to which he refers which engage the attention of the United States

Surveys. The explorations cannot be sustained by private individuals, and no private person can defray the expenses of the necessary publication. Labor is secured here at a cheaper rate by the government than in any other field, for salaries are small, and much work is done gratuitously. Students as a rule are poor, and the number of rich men engaged in its pursuit is small indeed. To withdraw government aid is to destroy a most useful competition, and to leave many departments at least in the hands of those few rich men.

But in further self-contradiction, Gen. Garfield gives qualified support to the proposed new organization of the government surveys by which all those at present in existence are to be abolished, and a single organization placed in its stead. Now the wholesome "competition between mind and mind," which he desires to encourage, could not be more effectually suppressed than by this method. As the surveys are now organized, they stimulate each other, offer a wider field for the development of science, and furnish a supply of intellectual food from which the text-books of the next half century will be drawn. And Gen. Garfield desires this work practically suspended, and the United States to retire from the position which she now holds in the commonwealth of nations, as a patron and producer of knowledge for her people.—*Philadelphia Bulletin.*

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On the Classification and Distribution of the Cray-fishes. By T. H. Huxley, Sec. R. S., V.P.Z.S. (Ext. from Proc. Zoöl. Soc., London, June 4, 1878. 8vo, pp. 751–788. From the author.

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GENERAL NOTES.

BOTANY.

On Nomenclature.—"I think it is about time that the notion that a species must necessarily be named after some peculiarity that it possesses, should pass into the limbo of exploded ideas." This passage, in the article "Walks Round San Francisco," in the Naturalist, December, 1878, page 791, induces me to

express my opinion on the use of personal names in scientific nomenclature.

Linnæus in his Philosophia Botanica proposes: "Nomina generica ad botanici *optime meriti* memoriam conservandam constructa sanite servanda sunt. Hoc unicum et summum premium laboris sanite servandum et *caste dispensandum.*" I agree with this proposition. Generical names established for the memory of the *most deserving* botanists should be kept sacred and imparted *abstemiously.*

Like the preacher, who warned his congregation to act according to his saying not according to his doing, Linnæus did not always strictly follow his own maxim, but the rule he proposes is a good one. Though I would prefer even for genera characteristic names, I would not blame an author who likes to honor the *most deserving*[1] botanists by baptizing genera after their names.

In regard to specific names, Linnæus advises against the use of names of persons or countries. He says: "Inventoris vel alius cujusquinque nomen in differentia non adhibeatur. Locus natalis species distinctas non tradit. Differentia specifica continet differentiæ *notas essentiales.*" Indeed a species that has not one character by which it can be distingushed from its congeners is not worth being called a species. In contradiction to this rule the Commission of European botanists, appointed by the International Congress at Paris, 1867, allowed the use of personal names. It is true what De Candolle says in the preface to those rules, that the Linnæan rules of nomenclature are obsolete, but just in this case I think Linnæus was right, and if that commission had considered how much personal names were misused and are misused in our time more than ever, then articles 32, 33 and 36 would not have passed in their present form. Of said misuse I could name many cases, but I take only one: Scheele published in *Linnæa* 114 new Texan plants, among which I count twenty-one *Rœmeriana*, fourteen *Lindheimeriana*, one *Grisebachii* and twenty *Texana.* When we deduct from the rest those which had already been described, more than half of all the new species got names which mean nothing more than a cheap compliment, worthless to a true scientist. The owners of the three above-mentioned personal names are botanists indeed (whether *most deserving* I am not competent to decide), but how often has a species to bear the name of a man who finds a new species as a blind hen finds a grain, or the name of the military commander of an expedition the collecting botanist was a member of, or the name of a friend of the species maker, whose connection with the object is looser yet. The most awkward thing is that, when a botanist mistakes a really new species for a known one, his mistake is rewarded by giving his name to the same new species which he did not recognize as such.

[1] Many are called, but few chosen.

There is another point in which I do not agree with the established rules: that is the right of priority, which the author of the "Walks" wishes to be extended even to wrongly spelled or ungrammatical names. This right of priority is the real source of premature publications and of the accumulation of synonyms. For example: Bertoloni, a respectable Italian botanist, professor in Bologna, receives a number of Alabama plants; he describes and names many new species which are known and named before. The trouble is, he is not enough acquainted with the North American flora and too hasty to leave the publication of new American species to an American author, who has at his disposition a greater quantity of specimens, which are necessary for a correct description. Now amongst those plants was perhaps a single poor specimen of *Petalostamon corymbosum*. Instead of laying it aside he describes it as the type of a new genus (*Gavesia*) in the order of Compositæ. How often in the same way we see a man who is not master of the synopsis, who does not know what is known, push his name before the scientific public, not from zeal for science, but from desire to see his "mihi" behind a new created species. Then true scientists have the trouble to clear the stable.

To meet the case at once there should be appointed an international committee, an Areopagus, in which the most prominent botanists should decide on the value of each specific name. Free competition would be left open, but the author of a name would have the risk of refusal. Better yet—we, the humble mortar carriers, should give over to the masters of systems all the pebbles and diamonds we find, and leave to them the task of assorting. The arena of science is wide, and there is chance enough to search for laurels outside of systematic botany.

And now one word about wrongly spelled or ungrammatical names. The Parisian congress has acknowledged the right to correct such bad names, and that is right. The best scholar may inadvertently make a mistake, and he will not be offended by being corrected. It is right to read *Astragalus aboriginum* instead of *aborigenorum*, and *Scytonema simplex* instead of *simplice.—Fred. Brendel.*

ASPIDIUM BOOTTII TUCKERMAN.—As the following note, prepared for my Catalogue of the "Davenport Herbarium" of North American Ferns, is supplementary to my paper on "*Aspidium spinulosum* Swz., and its varieties," published in the NATURALIST for November, 1878, I offer it here in advance of publication.

In my paper on "*Aspidium spinulosum* Swz., and its varieties" (AMER. NAT., l. c.) I was led to consider *A. boottii* Tuckerman and *A. remotum* Braun as identical, by an examination of a specimen of the latter, at Cambridge, from Braun's herbarium, and to credit Braun's name with being the oldest, on the authority of remarks in Hooker's "British Ferns," t, 22, but since the pub-

lication of my paper I have endeavored to learn the exact date of the publication of Braun's name, with the following result:

The record, so far as it appears from all accessible authorities, is, that in 1834 Braun first discovered in a mountain valley near Baden specimens of a fern, growing with *Aspidium filix-mas* and *A. spinulosum* (*dilatatum*) that he at first referred to *Aspidium rigidum* as a variety of that species (var. *remotum*), but which he afterward designated as a species, under the name of *Aspidium remotum*. Later he appears to have regarded it as a hybrid form between *A. filix-mas* and *A. spinulosum*, but finally, according to Milde (Fil. Eur. et Atl., 1867), considered it a form of *Aspidium filix-mas*.

Braun, however, does not appear to have published any description, and unless, as Mr. Watson suggests, he may have given the name previously in some catalogue of the Lipsic Garden, the name *Aspidium remotum* does not appear until about 1850, when it occurs for the first time in "Verjüngung," Freiburg, 1849–50.

On the other hand, Tuckerman's name and description was published in *Hovey's Magazine* for 1843, which entitles it to the right of priority, and justifies my retaining it on stronger grounds than those given in my paper on *A. spinulosum*.

The question of identity, however, still remains in doubt. The two ferns have generally been regarded as identical, by English authors, but Milde held the opinion (Nova Acta, 1858) that *A. remotum* had nothing whatever in common with *A. boottii*, and as his opinion was based on a careful study of the anatomy of the two plants, it is entitled to the very highest consideration.

In the face of the opinion of so careful and thorough an investigator as Milde, it is extremely unsafe for any one to hazard an opposite opinion, without a most careful and searching investigation, conducted on the same principles as those made by that eminent cryptogamic botanist; but I cannot forbear expressing the opinion that some of the external characters pointed out by Milde as separating the two ferns, are not altogether reliable, as, for example, the comparative length of the stipe, the chaffiness, or stoutness of the rachis, and the degree of pinnation in the frond, all of which characters certainly vary greatly in different specimens of *A. boottii*.

The difference, however, pointed out in the number of fibre-bundles in the stipe of *A. remotum* (7) as compared with the similar structure of the stipes in *A. spinulosum* and its forms (5 fibre-bundles) is a most important one, and one not to be lightly overlooked.

According to Milde, also, the indusium in *A. remotum* is without glands, whereas in *A. boottii* the indusium is finely glandular. But as these glands frequently disappear early, and are not always present after the indusium contracts, we cannot tell how much importance to attach to Milde's statement, without knowing ex-

actly in what state his specimens were when examined. Milde, himself, in another part of the same work, when speaking of *A. spinulosum* and *dilatatum*, apparently regarded the presence or absence of glands on the indusium as unimportant.

I shall discuss this question more fully hereafter; for the present I can only say that the specimen of *A. remotum* at Cambridge, from Braun's herbarium—the ticket is apparently in Braun's handwriting and bears date "Aulich, Sep. 1859"—appears to me identical with our *A. boottii!* If detached from the sheet and sent out for that fern, it would be generally received without question.

But in whichever way the question of identity is finally decided, its determination either way cannot affect the position of Tuckerman's name, which dates with Braun's earliest name (*Aspidium rigidum*, var. *remotum*, A. Br. in Dœll's Rheinische Flora, 1843) and is the oldest specific name on record. The name *Aspidium boottii* Tuckerman, therefore, must remain undisturbed.

I am greatly indebted to Mr. Sereno Watson, of Cambridge, and to Prof. Eaton, for their kindness in aiding me to look up authorities. (Geo. E. Davenport in Catalogue of the "Davenport Herbarium" of North American Ferns, Mass. Hor. Soc. ined. MEDFORD, Mass., Jan., 1879.)

Remarks—In my paper on *Aspidium spinulosum* I was inadvertently led into two errors of authority that I wish to correct here. *Aspidium spinulosum* var. *dilatatum* and *A. spinulosum* var. *boottii* should both be followed by Gray as authority, in place of "D. C. Eaton in Gray's Manual."

BOTANICAL NEWS.—Sir J. Hooker, in his recent address to the Royal Society, refers to the remarkable theory of Schwendener, now ten years old, affirming that the lichens consist of ascomycetal fungi united in a commensal existence with algæ. Indeed Stahl has manufactured such lichens, as *Endocarpon* and *Thelidium* by juxtaposition of the appropriate algæ and fungi. That minute plants (Bacillus) may occasion disease is apparently shown by the fact that the dried blood of horses that had died of the "Loodiana fever," in India, on being sent to England, there afforded seed from which a crop of *Bacillus anthracis* has been grown, which justified its distant pathological origin by reproducing the disease in other animals.

That gigantic undertaking, the Flora of Brazil, begun by Von Martius, is now being carried on by Eichler of Berlin, under the liberal auspices of the Emperor of Brazil. A little over a year ago Bentham's Flora of Australia was completed. It describes eight thousand species of plants.

Mr. A. W. Bennett contributes to *Nature* an account of the experiments of Rev. G. Henslow on the absorption of water by the leaves of plants, forming a sequel to and confirming those of Boussingault. That plants absorb water by their leaves, and that

gardeners should therefore continue to water plants by sprinkling their leaves, seem well established facts.

The *Bulletin* of Hayden's U. S. Geological Survey, Vol. IV, No. 4, contains a catalogue, by Prof. J. W. Chickering, of Phænogamous and vascular Cryptogamous plants collected during the summers of 1873 and 1874, in Dakota and Montana, along the forty-ninth parallel, by Dr. Elliott Coues, U.S.A.; with which are incorporated those collected in the same region at the same time, by Mr. George M. Dawson.

Trimen's *Journal of Botany* contains articles on a monandrous Cypripedium, by S. L. M. Moore, and a further note on the structure of Composites, by M. T. Masters. Braun's article on the vegetable remains in the Egyptian museum at Berlin, is translated from the Zeitschrift für Ethnologic, the first part appearing in the January number.

The *Bulletin* of the Torrey Botanical Club contains an account among other notes, by Prof. Gray, of a sporting *Trillium grandiflorum*, and of an *Agaricus* with the odor of chlorine, by C. F. Austin.

In the *Botanical Gazette* G. Vasey describes a new *Panicum*, *P. littorale* from Mobile. J. M. Coulter contributes an article on the flora of Northern Indiana.

ZOÖLOGY.[1]

Note on the Hairy-tailed Mole, Scalops breweri of authors.—The earliest description of a mole, referable to the genus *Scapanus* and to the species subsequently named "*Scalops breweri*" by Bachman, is that given by Harlan, Fauna Americana, 1825, p. 43, under the name of *Talpa europea*—he wrongly supposing that it was the common mole of Europe. He does not state whether he described an American or a European specimen; and the general drift of his remarks indicates that he compiled, at least in part, from some staple description of *Talpa europea*. But it is evident that he really had in view an American mole, which he recognized as distinct, both generically and specifically, from our common *Scalops aquaticus*.

That this is no other than the *Scapanus* is shown by the dental formula of forty-four teeth, which is applicable neither to *Scalops* nor to *Talpa;* and the rest of his description is incompatible in no respect with *Scalops* "*breweri*," which so closely resembles *Talpa europea* in superficial appearance that it has not seldom been mistaken for the latter. That there is no doubt in the case is further witnessed by Audubon and Bachman, who state (Quad. N. A. III, p. 219) that "Harlan had described the skull of the species we have since described and figured as *Scalops breweri*, having forty-four teeth," &c.

In connection with this description, Harlan published William

[1]The departments of Ornithology and Mammalogy are conducted by Dr. Elliott Coues, U. S. A.

Bartram's MS. name, "*Talpa americana*," which thus antedates the trivial name "*breweri*" of Bachman. It therefore becomes necessary to know the hairy-tailed mole as *Scapanus americanus*. —*Elliott Coues, Washington, D. C.*

THE CLOVER-SEED FLY, A NEW INSECT PEST.—At the annual meeting of the N. Y. State Agricultural Society, held at Albany in January last, J. A. Lintner, of the State Museum of Natural History, read a paper in which, among other injurious insects recently observed, he gave an account of the larvæ of an insect which had been discovered two years ago in several localities in Eastern and Northern New York, hidden within the seed-pods of the red clover (*Trifolium pratense*) and destroying the seeds. The perfect insect had not yet been seen, but the examination of the larva showed it to belong to the Cecidomyidæ, and in all probability very nearly allied to the wheat-midge, *Cecidomyia destructor*. A description of the larva was given under the name of *Cecidomyia trifolii* n. sp.

The range of this insect's depredations or the extent of its ravages was as yet unknown. In some localities in the western counties of the State of New York, the clover was so infested with it last year that it was worthless for seed. It is believed that the not infrequent failure heretofore reported of the clover-seed crop throughout the country, which has been ascribed to imperfect fertilization of the blossoms and various other causes, has been the result of the secret operations of this little insect.—*J. A. Lintner.*

THE ENGLISH SPARROW AND OUR NATIVE SONG-BIRDS.—The introduction of the English sparrow, and the substantial disappearance of the smaller song-birds from our cities and villages, have been nearly coincident in point of time, but it does not follow that they are connected as cause and effect. The imported bird is just making its appearance in the smaller villages of Northern Ohio, where it finds the territory substantially unoccupied. Our native songsters disappeared from these localities before they came in contact with the intruders. The house wren, the summer yellow-bird, the blue-bird, the green-finch, song-sparrow, chipping-sparrow, and the vireos, were, a few years ago, abundant in all these villages; now, but few of them are seen during the season. The robin is as abundant, and as great a plunderer of our small fruits as ever. The Baltimore oriole remains. The cedar-birds come for their feasts upon the apple-blossoms in the spring, and upon the cherries in their season. The slate-colored snow-bird takes up its winter quarters with us, and the crow black-bird and the cat-bird build their nests in our ornamental trees.

It can not be supposed that the native songsters retire in anticipation of the intrusion of their foreign cousins, and some other cause for their disappearance must be sought.

In this neighborhood, the want of appropriate nesting-places

is a sufficient explanation. The forests are now all enclosed, and constitute a part of the pasture lands. The undergrowth and thick masses of shrubs, brambles, and creepers have disappeared; the most of our little swamps are reclaimed; and as these changes have occurred in the forest and field, fashion has prescribed a smooth lawn, with scattered trees and clumps of summer bedding plants around our dwellings, in place of the thick masses of shrubbery which were cultivated a few years ago. And it is the birds which found their nesting-places and their food supplies in this shrubbery and undergrowth which have most thoroughly disappeared.

The robin finds good nesting-places and an abundance of summer food; the Baltimore oriole suspends its nest from the drooping branches of the elm; and both these birds are content to remain with us. In the forest and field, where the English sparrow does not intrude, the thrushes, the warblers, the fly-catchers, finches, and black-birds are by no means as abundant as formerly. Their nesting-places are greatly restricted, their food supplies diminished, and they find no thick copses, under the cover of which they delight to hide themselves, and in which so many find a large part of their supplies of food. Their nests are more exposed, and their life is made uncomfortable by these changed conditions, and they are driven to seek homes more congenial to their habits.

A care for our forest reserves, which will protect them from the intrusion of domestic animals, and permit the renewal of the dense undergrowth which has been destroyed, and the culture of thick masses of shrubbery about our dwellings, will secure a return of the exiles, and *perhaps* a contest for the occupancy with the imported birds. We shall then learn whether they can dwell together in amity or not.—*M. C. Read, Hudson, Ohio.*

ANTHROPOLOGY.[1]

HABEL'S ACCOUNT OF ANCIENT GUATEMALAN SCULPTURES.—The Smithsonian Institution will issue, in a few days, an illustrated pamphlet of eighty-six pages, by Dr. Habel, upon a wonderful series of sculptures from Santa Lucia Cosumalhuapa, Guatemala, near the capital. It is impossible, in a brief note to epitomize a work of such great merit. We give a few of the concluding remarks of Dr. Habel in his own words:

"These sculptures of Santa Lucia Cosumalhuapa are to me the most interesting of the kind that have been preserved of the ancient inhabitants of America, furnishing as they do, unequivocal proof of the advanced culture to which their constructors had attained. Those found in other localities represent either single individuals, or groups in which the relations are obscure; but the bas-reliefs of Santa Lucia in every case but one present

[1] Edited by Prof. OTIS T. MASON, Columbian College, Washington, D. C.

scenes in which there are generally two actors, one of them being a mythological personage. We are introduced into the very feelings and thoughts of the people, and learn much of their modes of living.

"We are enabled to decide the progress of a people by the perfection to which they had carried the useful arts, by the advancement which they had made in the fine arts and in scientific knowledge, by their religious conceptions, and by their language, including the methods of representing it. A comparison of these also acquaints us with those things which different peoples have in common. Let us therefore compare the sculptures of Santa Lucia with those of other parts of America in these four particulars, in order that we may perceive the resemblances between their fabricators, if any exist, and form some opinion of their comparative status in culture.

"As regards the useful arts, when we consider the hardness of the material, a dark gray porphyry from the volcano of Acatenango, we are convinced that the Santa Lucian sculptors used tools of great perfection. The advancement of technical skill is further attested by the variety of manufactures represented in the sculptures, such as wood-carving, textile fabrics, shell and metal work, leather work, carved stones, etc. The elevated character of these products of industry is attested by the uses to which they were put. With the exception of sculptures nine and fourteen, there is scarcely anything which indicates clothing merely. Nearly every article which is attached to the body is an ornament, although the drapery suspended from the girdle may have been introduced to hide the genital organs. The foot also may be said to derive some slight protection from its ornamented sandal. The neck, arms, body, and legs, however, are adorned and not clothed. The ornaments of the head, and especially those of the hair, are extremely profuse, reaching often to the ground. It is worthy of notice that no part of the body is mutilated for the sake of beauty, excepting the lobe of the ear, which even in our enlightened age serves the ladies as a means of perpetuating barbarism.

"Again, the variety of forms in the same object is an indication of progress. The headdresses are greatly varied. In one instance it is a crab, in another entwined serpents, and in others it is so complicated as to remind us of the fashions in highly enlightened nations. The most lavish care was bestowed on the hair, which in very few cases indeed appears without ornament, even on the heads of immolated victims. The method of ornamentation seems to have indicated the social position of the wearer. The hair is at times adjusted to resemble a wig, but is generally braided with ribbons, adorned with rings, etc., and reaches in cues to the shoulders and below them. Other yet more complicated ornaments reach to the ankles, and even trail upon the ground,

ending in some animal form, as an eagle, American tiger, or a fish. One of these ornaments which is met with in every case is in the form of a sheathed scimitar.

"This variety is again noticable in the ornamentation of the ear, which assume the form of rings, embossed disks, tassels, etc., and of the neck, which may be a single band, a double collar, a ring with pendant tassel, or a necklace of many rows of beads or stones.

"Generally the wrist of but one hand is adorned with a bracelet, which is either made of some textile fabric or consists of rows of stone or metal beads. The other hand is inclosed in a human skull or in that of a fierce animal. If these are the skulls of immolated victims, we have here the evidence of the sacrifice of animals as well as of human beings.

"The waist above the hip, is surrounded by a broad stiff girdle, the upper portion which stands off from the body. On the back part of it is usually seen the head of a ferocious animal with open jaws replaced in one instance by a human head. From the lower edge of the forepart of the girdle descend two kinds of sashes, the one surrounding the thighs, the other tied in a bow-knot in front. The material of these sashes varies greatly. In one instance it appears to consist of leaves and flowers; in another, that of the priest, it is replaced by a serpent. A twisted band tied in a bow replaces the girdle on the waists of the immolated victim.

"The ornamentation of the leg deserves especial attention. A band with pyriform pendant encircles the right leg below the knee. A single pendant is attached to the band in all cases, excepting that of the person sitting on a throne, where the entire lower edge of the band visible is occupied by six pendants. From this circumstance this person is supposed to have been the chief, or grand master —to use a heraldic term—of an order of which the others were simply knights or laymen. The occurrence of the same ornament on the neck of the figure supposed to represent the sun, indicates that an order may have existed in honor of the sun, and the members thereof may have been knights of the sun, who had their counterpart in the Virgins of the Sun in Peru.

"This instance of wearing a badge on the leg below the knee is remarkable in its resemblance to the Order of the Garter in England. It is impossible to suppose that one people imitated the other, but we have here a striking illustration of the development of similar thoughts and ideas in individuals and nations widely separated in time and space. This is further impressed in the fact that these knights only wore their distinctions on high and festive occasions, or when adoring their gods; while on ordinary occasions, as with the sick man, a simple rosette takes the place of the badge.

"The protection of the feet is greatly diversified. Exceptionally

both feet are nude, but generally the bottom of one or both feet is protected by a sole, which is rolled up more or less to cover the upper part of the foot. The toes, with few exceptions, remain unprotected, and in no instance is the covering of both feet alike.

"We come now to speak of the artistic taste of the sculptors of Santa Lucia as an indication of the superior culture of the people to whom they belonged. In the representation of natural forms we attribute the highest culture to those people who imitate nature most closely in her best manifestations. For this reason we should attribute to the ancient Greeks a very high degree of culture if we had received no other knowledge of their civilization excepting the relics of their works of art, which, when attempting to imitate nature, avoid all grotesqueness and caricature.

"In the sculptures of Santa Lucia the human form stands before us, not with ill-proportioned features, but in regular outline combined with marked expression of the countenance. The observance of these details proves a diligent study of the human body. That which does appear as grotesque, must not be attributed to a crude conception or to want of skill, but to the ornamentation, which has a barbarous luxuriance. If we examine the heads in the sculptures of Santa Lucia, we shall find that while they all possess the curved nose so characteristic of the aborigines of America, they have no stereotyped forms; on the contrary, this feature varies with the expression of the face, so as to individualize each person represented. Some of the faces are attractive on account of the quiet expression of their features; and one especially approaches very nearly to our sense of beauty. The engraving hardly does justice to the original.

"Again, just as each art passes through several stages in its progress to perfection, so among all arts there is the same gradation. Thus lyric and didactic .poetry are assigned a lower place than epic poetry, and the drama is the most elevated of all. Dramatic conception can originate and be cultivated only by a people who have passed the other stages. The monoliths of Santa Lucia show that their authors had cultivated the poetic sentiment as well as sculpture; for, not only do we find that they had statuary as well as low reliefs, but we have evidence of the degree of poetical elevation to which they had attained. All of the scenes represented are dramatic, and four of them are allegorical. In the two sculptures representing sick men, the individuals are doubtless of high standing. One of them is visited by death in the shape of a skeleton, who draws the attention of the sick man to the fact of his having lived for a number of years, indicated by the signs for numerals, and that it is, therefore, time for him to depart. In the other case, the sick man is visited by the medicine man in the guise of a deer, and reminded of the moderate number of years he has lived, as indicated by the numeral signs. This news would cheer him with the hope of recovery.

"In each of the other two allegorical sculptures, a human being is devoured by a bird—perhaps the Bird of the Sun—as it wears the image of the sun on the breast. This myth, again, has arisen independently in many lands.

"The advancement of a people is also said to be measured by their religious conceptions. If we inquire into the stage which the evolution of the religious sentiment had reached among the people of Santa Lucia, we shall find that they were passing from the adoration of the sun and other heavenly bodies to the worship of men—Anthropomorphism. Among the deities in the sculptures can still be found the sun and moon, but both represented with human forms. The entire body is not given, but only the upper, nobler part. In the images of the deities are preserved the natural human features, not disfigured by any addition of animal organs or fantastic attributes.

"The sculptures prove, alas! that human sacrifices were practised by their makers. The mode of immolation was peculiar. It was not the entrails of the victims which were dedicated to the gods, nor the heart torn from the breast and thrown at the feet of the idol; but we see here the noblest part of the body, the head, severed and presented to the deity.

"Finally, the language of a nation and the methods of representing it are valuable indications of their status in culture. The same may be said of their numeral system.

"It has been frequently affirmed that the aborigines of America had nowhere arisen high enough in civilization to have characters for writing and numeral signs; but the sculptures of Santa Lucia exhibit signs which indicate a kind of cipher writing, higher in form than mere hieroglyphics. From the mouth of most of the human beings, living or dead, emanates a staff variously bent, to the sides of which nodes are attached. These nodes are of different sizes and shapes, and variously distributed on the sides of the staff, either singly, or in twos and threes—the last named either separated or in shape of a trefoil. This manner of writing not only indicates that the person is speaking, or praying, but also indicates the very words, the contents of the speech or prayer. It is quite certain that each staff, as bent and ornamented, stood for a well-known petition which the priests could read as easily as those acquainted with a cipher dispatch can know its purport. Further, one may be allowed to conjecture that the various curves of the staves served the purpose of strength and rhythm, just as the poet chooses his various metres for the same purpose.

"In the supplications of human beings this staff and its knots have a simple form, in the speeches of death the bends are angular; but the staves emanating from the deities are exceedingly complicated, and proceed, not from the mouth, but from the head or neck. To the variously bent and ramified staves of the deities,

divers flowers, fruits, and mythological emblems are attached in addition to the ordinary nodes.

"Besides the modes of writing just mentioned the sculptures exhibit another method of representing emotions and aspirations not expressible in words. It consisted in wavy ridges or lines originating either from the mouth or from the girdle of the suppliant, and uniting at the upper extremity, or separated like the conventional sign for flames. The artists of Palenque have expressed a somewhat similar conception by a figure blowing a horn, from the end of which proceed similar wavy lines to designate either the music or the escaping breath. (Stephens, Incidents of Travels, c. ii, 354.) Besides these methods of expressing thought there are, as before mentioned, hieroglyphics, chiefly a circular ridge inclosing the head of an animal or a pointed trefoil.

"In regard to the signs for numerals, it is evident that the radix of their system, whatever may have been its value, was represented by a circle, the same sign indicating zero in our system. A single horizontal line may be taken for a unit, two lines intersecting as in a Roman X, some other value, and lines shorter than the unit may be taken for fractional parts. This system of recording numbers throws some light on the question whether the ancient inhabitants of Middle America had any intercourse with the civilized nations of Europe. Evidently, if by accident or design, Egyptians, Phœnicians, Jews, or any other race had imported their civilization into America, some traces of it would be exhibited here."

Anthropological News.—The following brief notices may be of interest to some: In the *Mittheilungen* der Anthropologischen Gesellschaft in Wien, Dr. M. Much has a paper (pp. 203–273) upon agriculture among the ancient Germans, in which he takes the ground that the ancestors of the present Germans were always a settled people in Germany. The paper evinces a great deal of learning. L'Evolution Sociale en Occident depuis le moyen age jusqu'à nos jours, by P. Lafitte, *Revue Occidentale*, Nov. 1878, 4 pp. Essai sur Symbolique Planetaire chez les Semites, H. Charency, *Revue Linguistique*, 1878. Bericht über die IX. allgemeine Versammlung der deutschen anthropologischen Gesellschaft, zu Kiel, 12.–14. Aug. 1878, in *Correspondenz-Blatt*, No. 10. The Races of European Turkey: Their History, Condition and Prospects, by Edson I. Clark, Dodd & Mead.

Esquisse. d'une Grammaire Raisonnée de la Langue Aleoute. V. Henry. *Revue Linguistique*, Oct.–Dec., 1878. Aborigines of the Housatonic Valley, E. W. B. Canning, *Magazine of American History*, Dec., 1878. Oregon: The origin and meaning of the name, *id.*, Jan., 1879. The Wanga Plant and Voudooism, *Philadelphia Medical Times*, 1878, p. 539.

GEOLOGY AND PALÆONTOLOGY.

MINERAL WAX IN UTAH.—Prof. J. E. Clayton of Salt Lake, has recently discovered an immense deposit of mineral wax in Southern Utah. He describes it as sixty miles long by twenty wide, in some places forming a bed twenty feet thick. It contains more or less clay in seams and layers. Prof. Newberry finds it to be ozocerite, and Prof. Wurtz has obtained from the same region zietriskisite.

MERYCOPATER AND HOPLOPHONEUS.—Having recently had the opportunity of examining the entire dentition of the lower jaw of the *Hyopotamus guyotianus* Cope,[1] I find that it does not belong to the genus to which I referred it, but to an allied one, which appears to be undescribed. It differs from *Hyopotamus*, having but three premolars and a simple diastema. The premolars are wide, and the last has four crescentoid cones, as in the first true molar (crowns of first and second lost). Canine well developed, compressed, anterior. The cones, both internal and external have a crescentic section. The inner cones are convex on the inner side in *Gelocus*, which also differs from this form as does *Hyopotamus*, in the simple compressed form of the premolars. The present genus may be called *Merycopater*. *M. guyotianus* was as large as the white-lipped peccary.

Fine specimens of the *Machærodus brachyops* Cope (l. c. p. 10), show that it possessed an inferior tubercular tooth. It therefore belongs to the genus *Hoplophoneus* Cope. It is a very much larger species than the *H. oreodontis* Cope.—*E. D. Cope.*

THE NATURE OF EÖZOÖN.—Dr. Karl Möbius contributes to Palæontographica for 1878, the results of his investigations into the structure of Eözoön from Canada. He used specimens received from Drs. Dawson and Carpenter. As an expert in the study of recent *Foraminifera* (*Rhizopoda*), Dr. Möbius's opinion carries with it much weight. His conclusion is, that the columns of the Eözoön limestone which Carpenter and Dawson supposed to be the casts of a canal system of the "intermediate or supplemental skeletons," are simply casts of fissures of various and unsymmetrical shapes having no resemblance to the tubules of any organic being. They are mostly flat, and frequently interrupted. The fibrous material found between the serpentine and the calcareous masses, supposed to be casts of the canals of the walls of the chambers of Eözoön, such as exist in the Foraminifera, consists of prismatic crystals of chrysotile. Dr. Möbius does not believe them to be casts of tubes, since no tube walls or interspaces can be seen by high powers either with or without polarized light.

THE AGE OF THE LARAMIE.—Prof. Schimper, of Strasburg,

[1] Palæontological Bulletin, 30, p. 15, Proceed. Amer. Phil. Soc. for November, 1878.

writes to Mr. Lesquereux to this effect in regard to the fossil plants of the Laramie group:

"I do not cease reviewing and studying your last magnificent publications which have given to phytopaleontology an immense forward impetus. 'Par lesquelles vous avez faite faire un pas immense à la paleophytologie.' You ask me to express my opinion on the age of your flora of the lignitic. It seems to me impossible that one can see in it anything else than a tertiary flora, unless one wishes to reverse all the data acquired by science until now. I consider this flora just as you do, as truly (franchement) eocene, not even pliocene, perhaps contemporaneous with Mt. Bolca or eocene, possibly a little more recent. It is very possible that in marine strata, intermediate to the land or lignitic deposits, one may find remains of cretaceous animals. It has been observed already many times that the modification to which the inhabitants of the land have been subjected, do not accord with those exhibited by the inhabitants of the sea. These are very often backward in their development, and this is quite natural from the slower action of the climate or climatic influence upon the inhabitants of the sea than upon those of the land. The facies of your lignitic vegetation is tertiary; it is impossible to change that. Messrs. the geologists have to decide as they may find proper."

On the Occurrence of a Solid Hydrocarbon in the Eruptive Rocks of New Jersey.—Mr. I. C. Russell states that associated with the sheet of trap rock known as the First Newark Mountain, which traverses the central portion of the Triassic formation of New Jersey, there occurs near Plainfield, at an abandoned copper mine on the western slope of the mountain—the upper surface of the trap sheet—an amygdaloid trap passing into a metamorphosed shale. In this region it is frequently impossible to distinguish in small exposures the genuine trap from the metamorphosed shales that rest in contact with it. Many of the cavities in the amygdaloidal rock are filled with a brilliant jet black carbonaceous mineral resembling very closely the albertite of New Brunswick. These cavities are frequently tubular in shape having a length of three or four inches and usually a diameter of about a quarter of an inch. Sometimes these tubes were lined throughout by infiltration, with a coating of quartz or calcite a line or two in thickness, before the carbonaceous material was introduced. Above the amygdaloid is found a metamorphosed shale which still retains its bedded structure, and in places presents something of the usual reddish color of the unaltered shales. This altered rock is traversed in various directions by seams and fissures, which are frequently filled with the same albertite-like mineral. Resting upon these metamorphosed beds occur slates, shales and sandstones, which contain fossil fishes and a considerable abundance of obscure vegetable remains. It seems evident that these organic bodies furnished by their

decomposition the carbonaceous material in the associated rocks. The heat derived from the slowly cooling injected rocks may have played an important part in this process.

The mineral whose geological occurrence we have thus described, gives, when subjected to chemical tests, almost precisely the same reactions as albertite. It is insoluble in heated acids and alkalies, and is but sparingly if at all soluble in alcohol, ether or oil of turpentine. Like albertite, also, it is infusible, but softens by heat and burns with a yellow flame, emitting an agreeable odor. It gives when incinerated a little less than 0.10 per cent. of ash.—*Amer. Jour. Sci. and Arts, August.*

THE HUDSON RIVER GROUP AT POUGHKEEPSIE.—As the result of the examination of the Hudson River region by Profs. Logan and Hall, these gentlemen traced the "Hudson River Group" as far as Rhineback, and gave that as its eastern boundary. At a June meeting of the Poughkeepsie Society of Natural Science, Prof. T. Nelson Dale (who has temporarily occupied the chair of geology at Vassar College) reported the occurrence of fossils *in situ* in the college grounds. The specimens shown and presented by him to the society were *Leptæna sericea,* an *Orthis* (undetermined) and some fragments of Encrinites. A few days ago Prof. Dale and the secretary of the Poughkeepsie Society of Natural Science, Dr. E. H. Parker, made a careful examination of the rocks on the west side of the river, opposite Poughkeepsie, and about a mile back, and were fortunate enough to discover large quantities of the same species of Brachiopods as those mentioned above, as well as some excellent specimens of what appear to be Fucoids, and similar to what Dana figures as *Buthotrephis.* This discovery would seem to show that the "Hudson River Group" extends perhaps as far as the Highlands.—*W. R. Gerard.*

GEOGRAPHY AND TRAVELS.[1]

AMERICAN GEOGRAPHICAL SOCIETY. PRESIDENT'S ANNUAL ADDRESS.—At the meeting of this Society held in New York, February 11, 1879, the President, Chief Justice Daly, delivered his annual address in which, instead of giving the usual summary of the progress of geographical exploration and research during the past year, he chose as his subject, "The History of Cartography, or the Progress of the Art of Map-making from the Earliest Times to those of Mercator." Cartographic Art, he stated, is probably as old or older than the invention of the alphabet, and has been found in use among races who had had no previous contact with civilized man nor any written language. The Esquimaux understood the charts of Parry and Ross and even extended lines of coast unknown to the explorers. The North American Indians have always had maps which were serviceable to them.

[1] Edited by ELLIS H. YARNALL, Philadelphia.

The earliest thing known in the nature of a map is the ground plan of a town identified as that of Susa, the Shushan of the Bible, a city of remote antiquity. The plan is supposed to be as old as the seventh century before Christ and represents with minute accuracy the details of the town. The Egyptians doubtless had maps and some general idea of the form of the earth. It is from the Greeks that we get our earliest knowledge of maps. Strabo says that Anaximander (B. C. 612) was the first who represented the world on a map. Parmenides, a contemporary of Herodotus, is said by Diogenes Laertes to have been the first person who asserted that the earth was of a spherical form and the same idea was entertained by Socrates. Strabo credits Parmenides also with having been the first to divide the globe into five zones, or, as they were then called, climates. Aristotle, half a century afterward, was convinced that the earth was a globe, drawing that conclusion from the shadow which it casts on the sun in eclipses. Crates (B. C. 325) constructed a globe of the inhabited part of the earth—from the arctic to the tropic in the form of a half circle. Dicearchus (B. C. 296) constructed a map of the world in oval form. With Eratosthenes (220 B. C.) the science of geography may be said to have begun. He devised what has ever since been employed as the most accurate means of determining the circumference of the earth, the measurement of an arc of the meridian. Hipparchus, a century later, first divided the globe by lines of longitude and latitude into degrees. Ptolemy of Alexandria (A. D. 250) is one of the best known of ancient geographers. His geography is based on the work of his immediate predecessor, Marinus of Tyre. The works of Eratosthenes, Hipparchus and Marinus have perished, and the geographies of Strabo, Pomponius Mela and Ptolemy are the only important works of the ancients that have come down to us. A period of 1200 years elapses from the time of Ptolemy to the inauguration by Prince Henry of Portugal of the spirit of maritime enterprise which led to the circumnavigation of Africa and the discovery of the continent of America. This includes the period of the Dark Ages. The Arabs from the ninth to the thirteenth centuries. however, assiduously cultivated geography. To them we owe the preservation of the works of Ptolemy. They determined the obliquity of the ecliptic and measured two arcs of the meridian. Through their intercourse with China the western world probably learned of the mariner's compass. The Chinese also had maps from a very remote period.

After the journeys of Marco Polo and Cademostra in the fifteenth century, many curious and remarkable maps were executed. On that of Benewitz (1524-48) the name "America" first appears. The last and greatest map is that of Gerard Krehmer, better known to the world by the Latinizing of his name as Mercator (1569). His projection not only gave the world in one view,

but showed the most effectual way for a vessel to sail in a straight line over a curved surface and thereby solved what was before one of the most difficult problems of navigation.

OBITUARY.—Dr. J. G. Kohl died at Bremen, his native city, October 28, 1878. He was born April 28, 1808. He was very widely known as the author of a very large number of geographical works and books of travel. These include accounts of travels in Russia, Poland, Austria, Hungary, Great Britain and Ireland, Denmark, Styria, the Alps, Netherlands, Dalmatia and Montenegro, etc. He came to America in 1854, and spent four years in travel, of which he told in books on Canada and the north-western States and Territories. He also wrote several works and papers on the early history, folklore and maps of America. One of his latest productions, remarkable for its learning and research, was a history of the discovery and voyages made to Magellan Straits.[1] He made many friends when in this country, and was a member of several of our historical and scientific societies.

Nicholas de Kanikoff, a Russian Orientalist, died near Paris on November 15, 1878. Born October 24, 1819, he at the age of twenty accompanied Gen. Perovski's unfortunate expedition to Khiva, and afterwards traveled much in Asia, especially in Bokhara, Persia (where he was Russian Consul General) and Afghanistan. He published (1845) Bokhara, its Amir and its People, and (1861) a Memoir on the Southern Part of Central Asia, for which the French Geographical Society gave him its gold medal. These and several other works are the source of much of our information concerning Central Asia.

MICROSCOPY.[2]

NEW MICROSCOPICAL SOCIETIES.—The Microscopical Society of Camden, N. J., was organized November 7, 1878, with eighteen members. Meetings are held on the first Thursday evening of every month, at the residences of members. The following are the officers for 1870: President, Albert P. Brown, Ph. G.; secretary and treasurer, Joseph L. De La Cour; managers, Harry S. Fortiner, C. Henry Kain, Samuel S. Cochran; curator, Alfred W. Test.

A Microscopical section of the Cincinnati Natural History Society has been recently formed, with fifteen or twenty members. Meetings are held on the first Friday evening of each month, at the rooms of the Society, with good attendance and the promise of interesting and valuable work.

The Rochester Microscopical Society was organized January 27, 1879, with a membership of nearly forty persons. From

[1] Geschichte der Entdeckungsreisen und Schifffahrten zur Magellan's-strasse und zu den ihr benachbarten Landern und Meeren. Von J. G. Kohl. Zeitschrift der Gesellschaft für Erdkunde zu Berlin, 1876. XI band, pp. 315 and 405.

[2] This department is edited by Dr. R. H. Ward, Troy, N. Y.

the number of prominent microscopists in that vicinity, an active and successful society may be looked for. The first officers are as follows: President, Prof. S. A. Lattimore; vice-president, C. C. Merriman; secretary, Dr. E. Line; treasurer, Dr. C. E. Rider.

AMERICAN QUARTERLY MICROSCOPICAL JOURNAL.—This new journal is published by Hitchcock and Wall, at No. 150 Nassau street, New York. The second number, just published, fully justifies the promise of the first, and establishes the Journal as a carefully edited and liberally published work, characterized by an abundance of elaborate memoirs upon microscopical subjects. Illustrations of a high grade are introduced when required. An able summary is also given of recent news and publications; though it may be doubted whether the news as such, can be given in a quarterly with sufficient promptness to meet all the requirements of modern science. It only remains for those who use the microscope or study its revelations to decide whether they will render the new enterprise permanent by making it self-sustaining. A good subscription list is all that is required in addition to what the proprietors have already accomplished.

SALE OF A MICROSCOPICAL LIBRARY.—The library of the late Jno. E. Gavitt is now being broken up, and catalogues of the books for sale can be obtained from his son, W. E. Gavitt, of Stockbridge, Mass. The library includes many rare and almost inaccessible works, which will be doubly valuable as mementos of one of the earliest American cultivators of Microscopy. Mr. Gavitt also possesses a very fine copper-plate portrait of old Anthony von Leeuwenhoek, which, though not specified in the catalogue, could probably be obtained by any one who would appreciate it at its real value.

SPRING CLIPS.—E. H. Hawley, of 102 Grove street, New Haven, Conn., has recently made spring clips for the use of several distinguished histologists. The clips are very light and neat, being made of light steel wire, and having a leather disk instead of a cork to press on the cover. They can be bought for seventy-five cents per dozen.

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SCIENTIFIC NEWS.

— WE are sorry to learn that the Legislatures of Georgia and North Carolina have suspended the geological surveys of those States. This is much to be regretted, since both regions will amply repay to the people the small amounts heretofore expended on them, if only continued long enough to permit the results to be elaborated and published. These measures are a blow at the educational interests of those States which we had not looked for from so-called " reform " legislatures.

— A recent number of the *Gold Hill* (Nevada) *News*, says: "The artificial lake at the mouth of the Sutro Tunnel swarms with fish from three to four inches in length. They were planted in the lake by some Indians about fifteen months ago. They have increased at a wonderful rate, and there now appear to be millions of them. These fish are likely to find themselves in literally hot water when pumping from the flooded mines has been commenced."

— We have received the fourth, fifth and sixth plates of Leuckart and Nitsche's Zoölogische Wandtafeln; these diagrams illustrating the structure of different types of the animal kingdom. Each diagram is a lithograph, costing in Germany from eighty pfg. to at most two marks. They are thus cheap, and on the whole most excellent, and will prove serviceable in schools and colleges. The present diagrams represent the Crustacea and the anatomy of the living crinoid *Rhizocrinus*. This is a most valuable diagram, and very cheap. The sixth represents the metamorphosis of the potato beetle, *Doryphora* 10-*lineata*, and is not particularly well done. One of the figures is not accurate, nor is the beetle sufficiently typical of the Coleoptera, to be selected as a subject for a diagram. They are published by Theodor Fischer, but can be imported, we suppose, through B. Westermann & Co., 524 Broadway, N. Y., or any other importers of German books.

— In the course of a couple hours' search last August, by Prof. A. S. Packard, Jr., and Mr. L. A. Lee, at the Fossil Fish Cut, Green river, Wyoming, the results of which were sent to Mr. S. H. Scudder for identification and description; nearly fifty new species of insects were discovered, showing that these beds are much richer in fossil insects than formerly supposed; nearly all the orders are represented; among them a new dragon-fly, several grasshoppers, eight new Hymenoptera, two new Heteropterous Hemiptera, and eighteen Homopterous Hemiptera, nearly all new and determinable, fifteen new species of Coleoptera, and twenty new species of Diptera. Mr. Scudder is engaged upon a general work on the Tertiary insects of the West, to be richly illustrated. It will form one of the quarto reports of Hayden's U. S. Geological Survey of the Territories.

— M. Lucien Lethierry, Lille, France, desires exchanges of Coleoptera, Hemiptera and Hymenoptera of the United States, for European species.

— Mr. Richard Rathbun is now publishing in the Proceedings of the Boston Society of Natural History, a paper on the Devonian Brachiopoda of the province of Para, Brazil. This constitutes a complete list of the Devonian Brachiopods at present known from the lower Amazonian valley, with descriptions of several new species.

— A paper was recently read by Mr. B. B. Redding before the

California Academy of Sciences, on the desirability of the introduction and culture of the olive in California. From the evidence presented it would seem that in the olive we have a tree that can be grown on the dry plains and naked hillsides of California. In the Eastern hemisphere its limits of profitable cultivation are as far north as the South of France, and as far south as Cairo, in Egypt. Wherever on the coast from San Diego to Monterey, and wherever in the interior of the State, within the limits of the temperature stated, there is an annual fall of rain sufficient to produce barley or wheat—on rocky hills and sandy plains, when once-rooted, this tree will thrive and bear.

— A Wilmington, California, paper, reports among the novelties of that neighborhood, a lake on Dominguez's ranch containing a great number of trout; the lake was stocked by an overflow of the San Gabriel river last winter; some of these fish have reached a foot in length. The settlers in the vicinity are revelling in this acquisition to the ordinary bill of fare.

— Mr. A. H. Curtiss, Jacksonville, Fla., has issued a second fascicle of 250 species and varieties of Floridan plants. Of most of the species enumerated he has specimens outside of his regular sets, as also of most northern plants, and if persons desiring a selection from them will make out a list of their desiderata (the numbers in Mann's Catalogue may be used) he will supply as many of them as possible at $10 per hundred. The fascicles will be forwarded from Cambridge upon receipt of the price, $20. The postage on packages or freight to New York or Boston will be paid by Mr. Curtiss.

— The unusually cold winter in California is indicated by the movements of the wild animals, which have been driven from their usual haunts in the mountains to the lower lands in the immediate neighborhood of the settlements.

The mountain lions, so-called (*Felis concolor*), are reported as very bold in San Gorgonio and San Jacinto, San Bernardino county, since the recent storms; in one instance intruding into the town of Banning in the night. In Carpenteria, Santa Barbara county, these animals made a descent upon a goat ranch and carried off sixteen Angora goats out of twenty-two; quite a loss to the rancher, as the Angoras are valuable stock. Deer are plentiful in the vicinity of Vallecito, Calaveras county, the storms having driven them from their higher retreats. It was recently reported in the local paper, that a party of Indians killed nine deer in one day's hunt. The farmers in and about Lower Lake in Lake county, also complain of the depredations of the "gray eagles" on their young lambs. In other parts of the State the grizzlies are prowling uncomfortably close to the settlements.—*R. E. C. S.*

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

AMERICAN GEOGRAPHICAL SOCIETY, Jan. 14th.—Major A. G. Constable lectured upon Afghanistan, the present seat of war, and the relations of that country to England and Russia.

Feb. 11.—Chief-Justice Daly delivered his annual address, the subject being Cartography, the history of map-making previous to the time of Mercator.

BOSTON SOCIETY OF NATURAL HISTORY, Dec. 18. — Dr. H. Hagen made a communication on the carpet-beetle and other house and museum pests.

Jan. 1, 1879. — Mr. L. S. Burbank remarked on a definite chronological record in certain stratified rocks; also on veins and enclosures in the granite of Rollstone Hill, Fitchburg, Mass., and exhibited crystals and cut gems of yellow beryl from Fitchburg.

Jan. 15—Prof. R. H. Richards remarked on some optical phenomena seen at Lake Superior. Prof. N. S. Shaler spoke concerning the Brighton Amygdaloids.

Feb. 5.—Dr. S. Kneeland read a paper on the monstrous in art, or the relations of zoölogy to symbolism. Mr. W. O. Crosby remarked on the fossiliferous boulders of Cape Cod. Dr. T. Sterry Hunt referred to recent studies in Pre-Cambrian geology.

APPALACHIAN MOUNTAIN CLUB, Jan. 8.—At the election of officers for 1879, Prof. Charles E. Fay was elected president. Mr. Frederick A. Ober read a paper on his explorations in the Lesser Antilles (illustrated by stereopticon views).

Feb. 12.—Mr. J. Raynor Edmands read a paper on the identification of distant points, with a description of Prof. Fernald's recent determination of the position of Mt. Katahdin, Me.

PROCEEDINGS OF THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA, December 17, 1878.—President, Ruschenberger, in the chair; Mr. Meehan made some remarks on the seeding of Catalpa, stating that terminal flowers only perfect seed. Mr. Ford from a perfect specimen of *Nautilus pompilius* suggested that the use of the siphon was to keep alive that part of the shell constituting the chambers. Mr. Ryder offered some observations on variations in the number of toes of young *Amphiumæ*, suggesting that the two hitherto recognized genera were hardly yet differentiated from each other.

December 31.—Dr. Ruschenberger in the chair. Dr. Koenig gave the results of an analysis of a new mineral substance which he proposed to call *Randite*, provisionally. In the election for officers to serve for the ensuing year, which occurred at this meeting, no changes were made from those who served during the preceding anuual term.

January 7, 1879.—Dr. Ruschenberger in the chair. The President announced the death of the Rev. Dr. E. R. Beadle, January

6th, aged 66 years. Messrs. Redfield, Rogers, and Leidy were appointed a committee to draft resolutions expressive of the Academy's esteem for Dr. Beadle. The annual reports of the Sections were then read and referred to the publication committee.

January 14.—Dr. Ruschenberger in the chair. Mr. Redfield for the committee, offered a resolution regarding the death of Dr. Beadle, which was unanimously adopted.

Mr. H. A. Kelly exhibited some handsome and perfect casts of batrachians taken from the animals themselves in gelatine molds. Mr. Ryder said he had recently observed that the jaws of herbivora were moved from without inwards, instead of the reverse, which threw new light upon the subject of the "mechanical genesis of tooth-forms." Dr. Leidy exhibited some lemons with a species of coccus or scale insect adhering to the rind, which he thought might become a serious pest in Florida, from whence the specimens were obtained. A letter accompanied with blanks, from Charles F. Folsom, was read by the President, requesting the coöperation of the members of the Society, in the collection of statistics relating to the subject of heredity.

December 16th, 1878.—Biological and Microscopical Section, Dr. R. S. Kenderdine in the chair. Professor J. Gibbons Hunt delivered a very interesting lecture on the lichens. His remarks were beautifully illustrated by many fine specimens of his own preparation, demonstrating the minute structure of these simple plants, which are found everywhere encrusting rocks, stones, the bark of trees, etc. A dish in which a large number of specimens were tastefully arranged by Professor Hunt under a bell-glass attracted much attention, forming as it did a display quite equal in beauty to the handsomest fernery. Speaking of their habitat, the speaker said that these, as well as many other interesting plants, were found in the greatest profusion and variety in the swamps of New Jersey, which he called the paradise of the botanist. After going briefly over the classification of these plants, the lecturer entered upon their anatomy. The great interest and value of the study of these plants as a means of mental discipline, and their use in the arts of design, were also dwelt upon by the speaker. Mr. Lewis exhibited a specimen of a rare wheel animalcule of marvelous beauty belonging to the genus *Stephanoceras* from the vicinity of Philadelphia.

Jan. 6.—Biological and Microscopical Section, Dr. R. S. Kenderdine in the chair. Dr. Carl Seiler favored the society with a discussion of the leading facts of animal histology, the branch of science which has for its subject-matter the consideration of the various kinds of cells composing animal bodies. He considered the classification of the living tissues according to their offices. These, he said, could be very simply and conveniently divided into three classes, as follows:—1st, connective; 2d, epithelial; and 3d, the nervous.

The speaker's remarks were illustrated by numerous beautiful microscopical objects prepared by himself, some of which showed as many as four different colors, each component part of the cells being of a different color, all of which had been accomplished by artificial means, though the process was comparatively a simple one. The great practical use of the study of histology and the comparative ease with which its main principles might be acquired, were dwelt upon, as well as the great facilities which were now offered to students owing to the mechanical and optical perfection of American microscopes, and the excellence of the technical processes devised and discovered by our own students.

Some further remarks were make by Dr. Dixon, Mrs. Professor White and Dr. Hunt, the latter of whom differed with Dr. Seiler in relation to some minor points relating to the origin of the connective tissues.

Mr. J. A. Ryder then offered a résumé of recent researches on the very first stages of cell-division and multiplication as worked out by the younger European biologists, who seem to have left off where the older workers began. These researches, he believed, indicated more decidedly than ever the identity of animal and vegetable protoplasm. In both the animal and vegetable cell the behavior of the central nucleus of the cell seemed to be quite the same; as it elongated preparatory to division, it was seen to be composed of two opposite poles, from which very minute granules were disposed in lines radiating in every direction, whilst curved lines of granules connected the poles. The appearance was that presented by iron filings scattered on a plate of glass, and made to arrange themselves in a curious fashion when the poles of a horseshoe magnet are applied beneath. It was not claimed that the process of cell-division was a magnetic process, but it was simply a resemblance which was suggested between the two phenomena. The curved lines of granules uniting the poles of the cell-nucleus, in the course of time, form nodes or enlargements which mark the point of division equatorially of the cell into two. The radiate arrangement of the granules at the opposite poles of the nucleus has induced Fol to call it an *amphiaster*, meaning like two stars joined together. The formation of the female and male pronucleus in the egg-cell was also considered, and shown to be produced previous to fertilization, at least in the case of a star-fish and a small species of leech. Many further observations were offered in regard to certain recently-discovered phases of embryonic development.

Mr. Lewis exhibited a fine living specimen of wheel-animalcule, the Lymnias.

SELECTED ARTICLES IN SCIENTIFIC SERIALS.

AMERICAN JOURNAL OF SCIENCE AND ARTS. — January, 1879. Mesozoic strata of Virginia, by W. M. Fontaine. Notices of fifty species of east-coast fishes, by G. B. Goode and T. H. Bean. Age of the clay slates and grits of Poughkeepsie, by J. N. Dale, Jr. New order of extinct reptiles (Sauranodonta), from the Jurassic of the Rocky Mountains; principal characters of American Jurassic Dinosaurs, by O. C. Marsh. Early Types of Insects, by S. H. Scudder.

February.—Has Lake Winnepeg discharged through the Minnesota within the last two hundred years? By J. E. Todd. The relation of secular rock-disintegration to loess, glacial drift and rock basins, by R. Pumpelly.

PSYCHE.—September–December, 1878. Life history of Danais Archippus, by T. L. Mead. Breeding habits of Callosamia promethea, by C. E. Webster.

January, 1879.—The nervous system of Phylloxera, by E. L. Mark.

QUARTERLY JOURNAL OF MICROSCOPICAL SCIENCE.—January. On the existence of a head-kidney in the embryo chick, and on certain points in the development of the Müllerian duct, by F. M. Balfour and A. Sedgwick. Notes on some reticularian Rhizopoda of the Challenger expedition, by H. B. Brady. Researches on the Flagellate Infusoria and allied organisms, by O. Bütschli. The morphology and systematic position of the Spongida, by F. M. Balfour. Flagellated organisms in the blood of healthy rats, by T. R. Lewis.

THE GEOLOGICAL MAGAZINE.—December, 1878. On the occurrence of a fossil tree in the Upper Silurian of Ohio, U. S., by E. W. Claypole.

ZOOLOGISCHER ANZEIGER.—December 16. Voges, on the Morphology and anatomy of Julidæ.

CANADIAN NATURALIST.—December 20th, 1878. Graptolites of the Niagara formation, by J. W. Spencer. On some marine invertebrata from the West Coast of North America, by J. F. Whiteaves. Description of a new species of Paragorgia from Jervis Inlet, B. C., by A. E. Verrill.

THE GEOGRAPHICAL MAGAZINE.—December, 1878. The Bolan Pass (Map). Account of the Dutch Arctic Expedition, by one of the seamen. Voyages between Northern Europe and Siberia in 1878. Darien Interoceanic Canal. (This Journal ceases to exist with this number.)